Appendix A

Descriptions and Examples of Hydrogeomorphic (HGM) Wetlands Classes for the Donlin Gold Project

A.1 Riverine Wetlands

In general, riverine wetlands occur in active floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Additional water sources may include groundwater discharge from surficial aquifers, overland flow from adjacent uplands and small tributaries, and precipitation. Riverine wetlands lose surface water by flow returning to the channel after flooding and during precipitation events. They lose subsurface water by discharge to the channel, movement to deeper groundwater, and evapotranspiration.

In Alaska, riverine wetlands range from broad floodplains along large meandering river channels such as the Yukon and Kuskokwim rivers to narrow, temporarily flooded zones bordering higher gradient rivers and streams. Extremely large riverine wetlands complexes can be found on deltas such as the Yukon-Kuskokwim Delta, the Copper River Delta, and the Stikine River Delta.

In the facilities study area (FSA) portion of the Donlin Gold project area, riverine zones occur along the Kuskokwim River and adjacent to large streams such as Donlin Creek and Crooked Creek. Narrow riverine wetlands dominated by willow (*Salix* spp.), alder (*Alnus* spp.), and spruce (*Picea mariana* and *P. glauca*) occur along small streams and creeks such as Eagle Creek, Crevice Creek, and Snow Gulch (see Photograph A.1-1). In areas where small streams flow from hilly terrain into gently sloping valley bottoms, the riverine wetland zones often become wider and wetter (i.e., seasonally flooded and semi-permanently flooded). While woody plants dominate most of the riverine wetlands in the FSA, some areas are characterized by a dense cover of sedges and/or grasses. These herbaceous riverine wetland zones often occur in areas where beavers are active, and along low gradient stretches where stream channels are less entrenched and overbank flooding is more frequent.

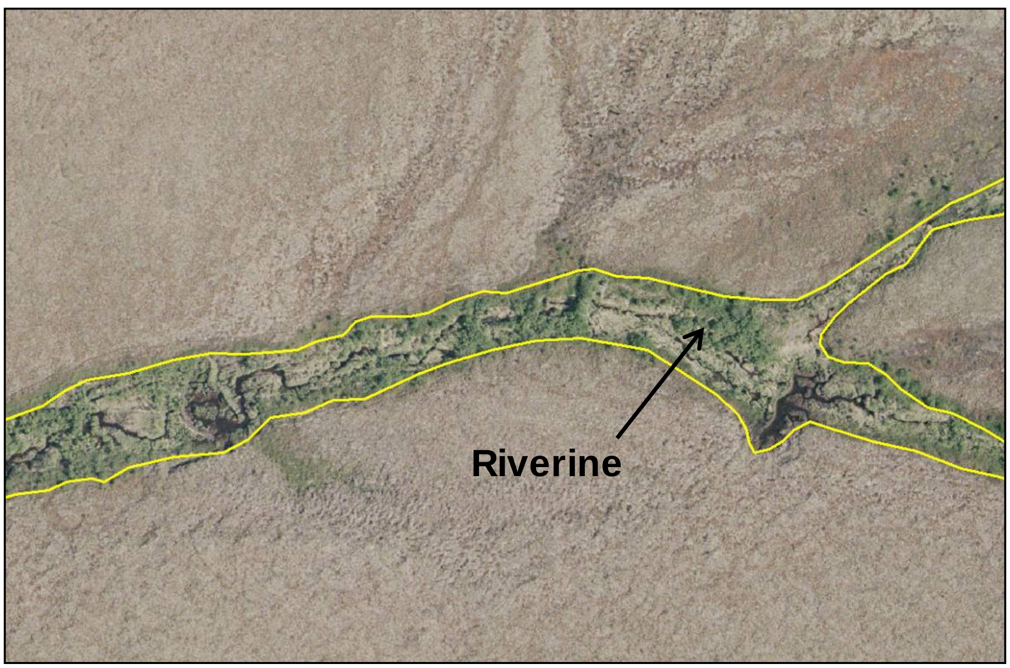
Along the pipeline study area (PSA) corridor, riverine wetlands include broad floodplain areas along major rivers such as the South Fork Kuskokwim River and Big River, marshes and shrub swamps along streams influenced by beaver activity, and narrow willow (*Salix* spp.) zones along high gradient streams. In southern portions of the PSA corridor, the riverine hydrogeomorphic (HGM) class also includes sedge (*Carex* spp.) and bluejoint grass (*Calamagrostis canadensis*) - dominated marshes bordering streams that meander through low gradient areas (see Photograph A.1-2).

A.2 Slope Wetlands

Slope wetlands normally occur where there is a discharge of groundwater to the land surface. They usually exist on sloping land surfaces from steep hillslopes to nearly level terrain. Slope wetlands are usually incapable of depressional storage. Principal water sources are groundwater return flow and interflow from surrounding non-wetlands as well as precipitation. Hydrodynamics are dominated by downslope unidirectional flow. Slope wetlands can occur in nearly level landscapes if groundwater discharge is a dominant source to the wetlands surface. Slope wetlands lose water by subsurface and surface flows and by evapotranspiration.

Examples of slope wetlands in Alaska include patterned fens, hillside seeps, spring-fed wetlands, and wetlands at the base of bluffs or toeslopes where groundwater is discharged near the surface. Some of the largest slope wetlands are string bogs on the broad glacial outwash plain west of the Parks Highway between Willow and Trapper Creek, Alaska.

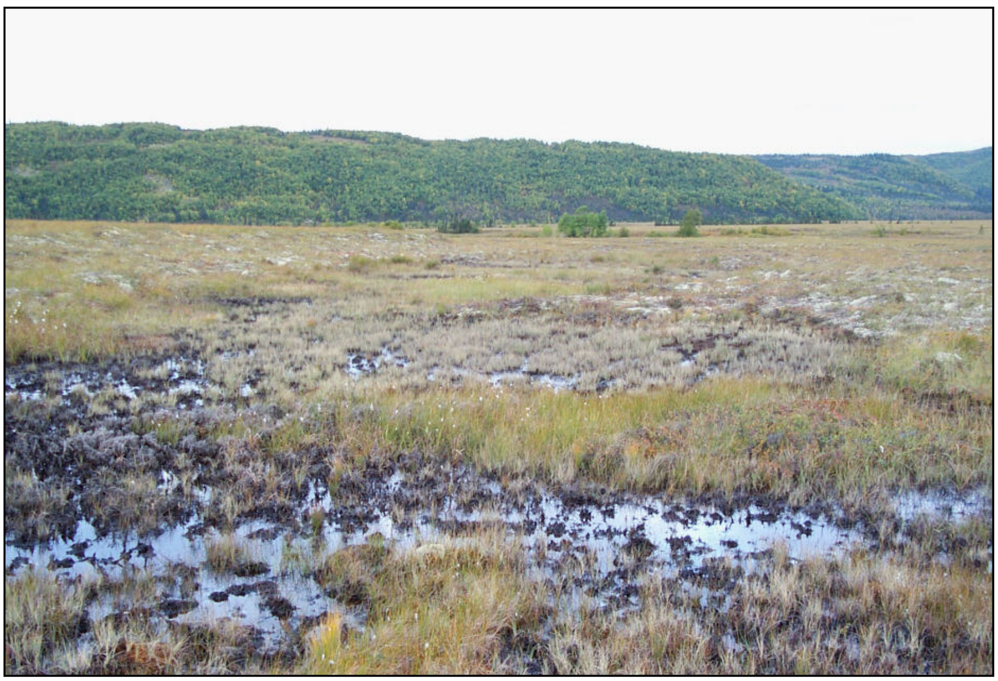
Photograph A.1-1. Seasonal flooded riverine wetland along Crevice Creek.



Photograph A.1-2. Riverine wetland, Owhat River Valley.

In the FSA portion of the Donlin Gold project area, slope wetlands are common on foot slopes and in drainageways where stream channels have not formed. In some valley bottoms, slope wetlands complexes form where water at or near the surface moves slowly through wide swales that often have a gradient of less than 2 percent. Slope wetlands on footslopes are usually dominated by scrub black spruce (*Picea mariana)* with an understory of ericaceous shrubs and a dense mat of sphagnum moss. These areas are usually significantly wetter than the adjoining steeper hillsides. A change in gradient often demarks the uphill limit of the slope wetland, and it is usually the zone where groundwater discharge occurs.

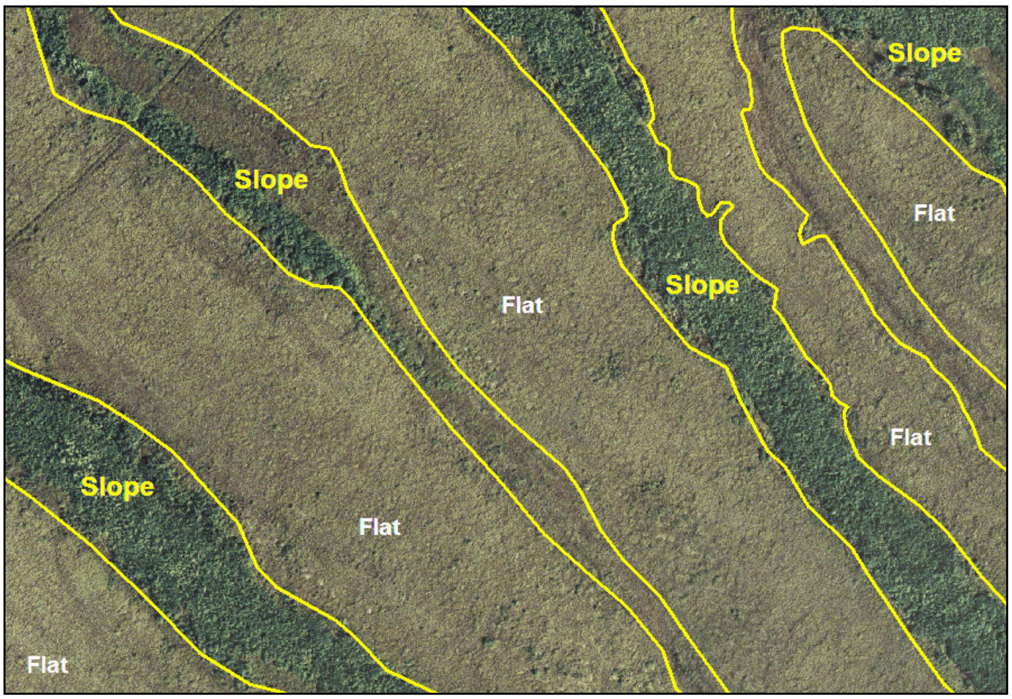
The narrow slope wetlands that form in drainageways on hillsides are usually dominated by tall willow (*Salix* spp.)*,* but some are dominated by low shrubs and others are predominately herbaceous wetlands. Slope wetlands in the valley bottoms are often very wet with surface water present throughout the growing season. Herbaceous plants tolerant of aquatic conditions (e.g., water sedge [*Carex aquatilis*]) dominate these seasonally flooded and semi-permanently flooded bottomland slope wetlands (see Photograph A.2-1).



Photograph A.2-1. Seasonally flooded slope wetland in a low gradient swale.

In the western portion of the PSA corridor (MP221 to MP315), slope wetlands are similar to those described above for the FSA because both of these areas are in the same ecoregion (Kuskokwim Mountains).

Between MP156 and MP221 of the PSA corridor, the project area passes through the Tanana-Kuskokwim Lowlands ecoregion. In the eastern part of this section, slope wetlands include swales and drainageways in rolling terrain where the bordering vegetation is in the flats HGM class and consists of low shrub and/or tussock tundra (see Photograph A.2-2). Similar slope wetlands are common in the western portions of the Tanana-Kuskokwim Lowlands ecoregion section of the corridor, except here the bordering flats HGM class wetlands are dominated by scrub black spruce (*Picea mariana*). In addition to the swales and drainageways, slope wetlands in the western end of this section include black spruce forested wetlands on footslope and toeslope positions where hillsides become wetter.



Photograph A.2-2. Slope wetlands in drainage-ways bordered by flat wetlands, Milepost 178 of the PSA.

The PSA corridor passes through the Alaska Range ecoregion between MP82 and MP156. In lower elevation portions of this section, broad slope wetlands occur in the form of fens on gently sloping terrain. These low shrub and herbaceous-dominated wetlands are most common in the vicinity of MP149 just west of the South Fork Kuskokwim River. Similar slope wetlands are common in some eastern portions of the Alaska Range section, such as in the Happy River Valley. Where the corridor passes through rugged mountainous areas, wetlands classified as slope HGM are limited primarily to small seep wetlands where the steep hillsides meet valley floors. In the very eastern part of the Alaska Range section, shrub-dominated fens interspersed with upland mixed forest are the most common type of slope wetlands.

Slope wetlands in the form of string bogs are common in the easternmost stretch of the PSA corridor (MP0 to MP82) where the study area is located in the Cook Inlet Basin ecoregion. String bogs are wetlands with organic soils that have roughly parallel shrub-dominated ridges (strangs) separated by wet pools (flarks). The strangs are oriented perpendicular to water movement within the bog complex. One of these bog complexes extends for 4 miles (MP0 to MP4) along the edge of the corridor. Transition zones dominated by scrub black spruce (*Picea mariana*) often occur along the edge of these wetlands. Slope wetlands in the eastern part of the PSA corridor also include low shrub and sedge (*Carex* spp.) -dominated fens near treeline. These seep-fed wetlands are common between MP11 and MP19. Similar hillside seep wetlands occur as forest openings where the PSA corridor passes through lower foothill zones.

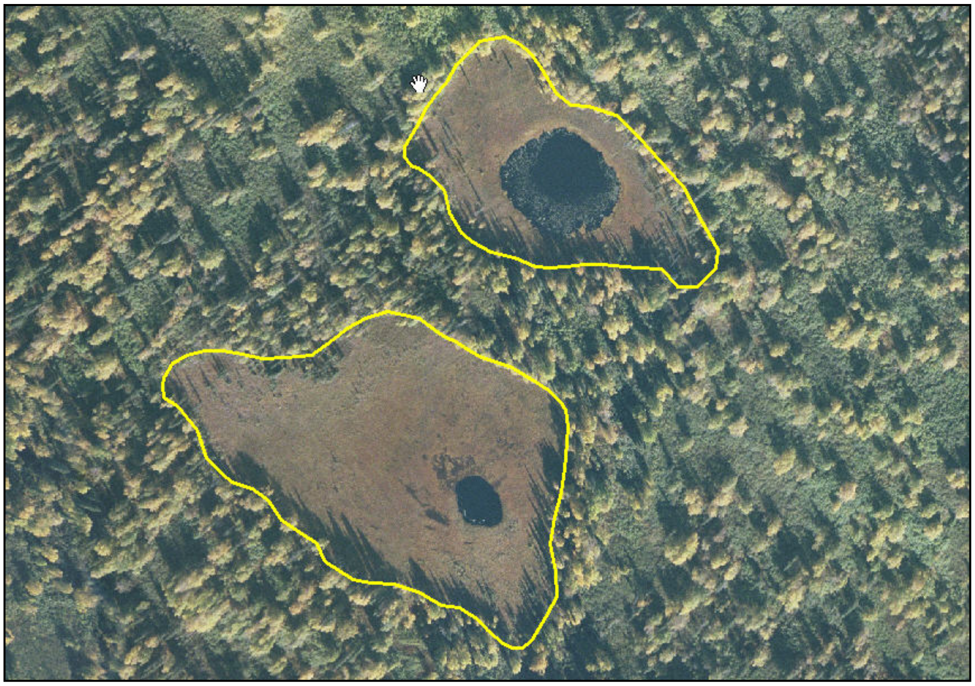
A.3 Depressional Wetlands

Depressional wetlands occur in topographic depressions on a variety of geomorphic surfaces. Dominant water sources are precipitation, groundwater discharge, and surface flow and interflow from adjacent uplands. The direction of flow is normally from surrounding non-wetlands areas toward the center of the depression. Elevation contours are closed, allowing for the accumulation of surface water. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Dominant hydrodynamics are vertical fluctuations, primarily on a seasonal basis. Depressional wetlands lose water through intermittent or perennial flow from an outlet, evapotranspiration, or contribution to groundwater.

From a national perspective, depressional wetlands include prairie potholes, vernal pools, glacial kettles, Carolina bays, small playas, and dune-swale wetlands. In Alaska, depressional wetlands include kettles and closed bogs in glacial deposits, ponds and closed-basin marshes dotting the landscape in coastal plains, water-holding basins in alpine zones, and abandoned channels and oxbow features on old terraces above active floodplains. Depressional wetlands are often embedded within another HGM wetlands class, such as well-defined ponds within a flats HGM complex.

In the Donlin Gold project area in the vicinity of the FSA, depressional wetlands are limited in extent. They occur primarily as abandoned river features (e.g., oxbow basins) on terraces above active floodplains. Depressional wetlands are also uncommon in the western portion of the PSA corridor (MP221 to MP315), where the corridor is contained within the Kuskokwim Mountains ecoregion. They occur primarily in clusters on terraces where the Donlin Gold project area crosses large rivers such as the Kuskokwim River and the George River.

In the Tanana-Kuskokwim Lowlands section of the PSA corridor (MP156 to MP221), depressional wetlands occur mostly in scattered groups either as kettles on moraine landforms or as very small bog features embedded within large flat wetlands dominated by scrub black spruce (*Picea mariana*). There are also some evenly spaced, small shallow depressional features in expanses of tussock tundra in several areas, such as on terraces adjacent to the Middle Fork Kuskokwim River floodplain. In the Alaska Range section, most of the wetlands in the depressional HGM class are of glacial origin, particularly kettle basins on moraine landforms. They are scattered along the PSA corridor, especially in the eastern and western ends of the Alaska Range section. Similar depressions are founds along much of the PSA corridor in the Cook Inlet Basin section (MP0 to MP82). This segment of the pipeline route has significantly more depressional wetlands than are found in the other parts of the Donlin Gold project area. A typical example from MP53 is shown in Photograph A.3-1.



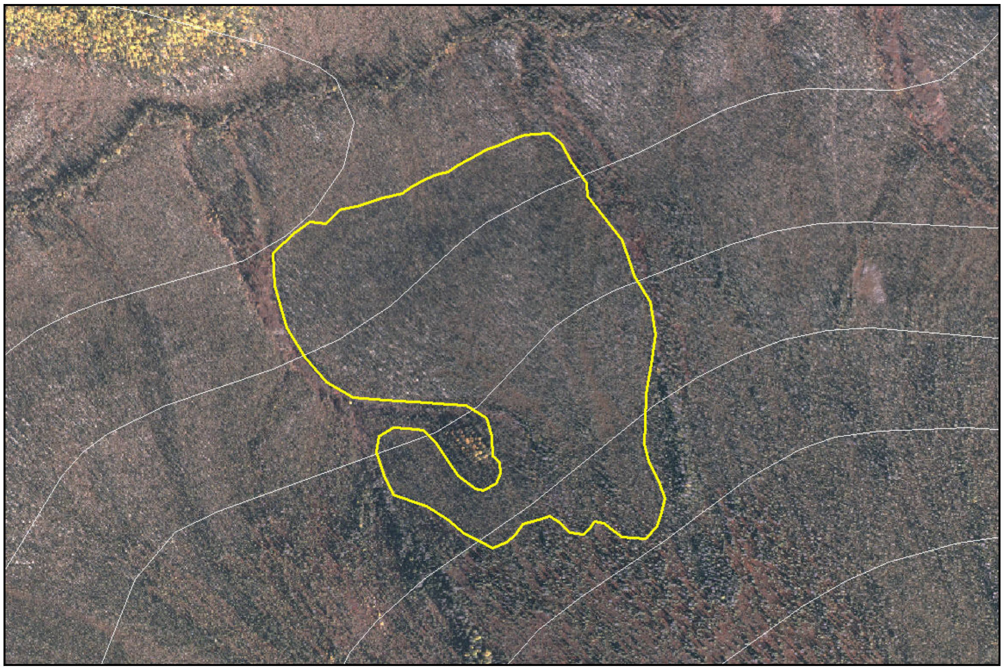
Photograph A.3-1. Depressional HGM basins, Milepost 53 of the PSA.

A.4 Flat Wetlands

Flat wetlands are most common on interfluves, extensive relic lake bottoms, and floodplain terraces above active river flooding. The water source of flat wetlands is dominated by precipitation, and the dominant hydrodynamics are vertical fluctuations. Flat wetlands receive virtually no groundwater discharge, which distinguishes them from depressions and slopes. Flat wetlands usually have a mineral soil. However, the flat class also includes wetlands called extensive peatlands that are characterized by vertical accretion of organic matter. Flats lose water by evapotranspiration, overland flow, and seepage to underlying groundwater. They are characterized by low lateral drainage, usually due to low hydraulic gradients.

In Alaska, flat wetlands cover vast areas where shallow permafrost tables perch precipitation at or near the surface. These "flats" may occur on sloping terrain such as the millions of acres of tussock tundra dominated by tussock cotton-grass (*Eripohorum vaginatum*) on the low, rolling hills of the North Slope region. Black spruce (*Picea mariana*) -dominated hillside forests and woodlands in interior Alaska are generally considered to be flat wetlands if permafrost occurs at a shallow depth. Large flat wetlands can also be found on broad glacial outwash terraces and in parts of valley bottoms where there are broad, shallow basins that do not exhibit lateral water movement.

Flat wetlands are the most extensive HGM class in the Donlin Gold project area. As is typical of interior Alaska, many of the hillsides (particularly north-facing slopes) in the FSA are classified as wetlands and considered to be in the flats wetlands class (see Photograph A.4-1). These areas are usually dominated by black spruce (*Picea mariana*) and may contain scattered larch (*Larix laricina*). On some slightly convex ridgetops in the FSA and in the western part of the PSA corridor, flats HGM wetlands consist of alpine shrub tundra or low shrub-dominated communities. Flat wetlands also occur on nearly level, old, river terraces above active floodplains, such as along Crooked Creek. These flats are typically vegetated with scrub black spruce (*Picea mariana*) and have a shallow depth to permafrost.



Photograph A.4-1. HGM flats black spruce wetland on hillside.

In the section of the PSA corridor where it passes through the Tanana-Kuskokwim Lowlands ecoregion (MP156 to MP221), extensive areas of flat wetlands occur on glacial outwash plains, interfluves, and other landforms with gently rolling topography. These areas consist of low shrub tundra and tussock tundra dominated by tussock cotton-grass (*Eriophorum vaginatum*) and generally have permafrost occurring at shallow depths. They are the most common wetland type in the 30-mile stretch from MP154 to MP182. West of this area, flat wetlands in similar landscape positions are also very common. However, the dominant vegetation changes from low shrub tundra and tussock tundra to scrub black spruce (*Picea mariana*). In many areas, the spruce canopy has been burned, leaving dead snags over low shrub communities.

In the Alaska Range ecoregion between MP82 and MP156 of the PSA corridor, flats HGM wetlands are scattered along the route mostly in the east and western portions of this section. They include spruce-dominated forested wetlands on lower slopes where there are shallow depths to permafrost, wetlands on old terraces above active floodplains, and low shrub tundra wetland areas on rolling terrain in valley bottoms (e.g., Happy River Valley).

In the easternmost section of the corridor (Cook Inlet Basin ecoregion: MP0 to MP82), the most common type of flat wetland is peatland on level to nearly level terrain. These large bogs are in broad, shallow depressions and are similar to the string bogs described below for the slope HGM class. However, the flat peatlands do not display evidence of downslope unidirectional flow of water that is characteristic of slope wetlands. The peatland bogs are typically vegetated with ericaceous shrubs with zones of black spruce (*Picea mariana*) along the edges.

A.5 Lacustrine Fringe Wetlands

Lacustrine fringe wetlands occur adjacent to lakes where the water elevation of the lakes maintains the water tables in the wetlands. Water bodies equal to or greater than 20 acres or greater than 2 meters in depth in the deepest part of the basin are considered lakes. Smaller or shallower water bodies and their fringing wetlands are generally considered to be depressional wetlands.

In some cases, lacustrine fringe wetlands consist of a floating mat attached to land. Additional sources of water are precipitation and groundwater discharge. Surface flow is bidirectional, usually controlled by water-level fluctuations such as when large precipitation events raise the water level in the adjoining lake. Lacustrine fringe wetlands lose water by flow returning to the lake after flooding and by evapotranspiration. Organic matter normally accumulates in areas sufficiently protected from shoreline wave erosion. Examples of the lacustrine fringe HGM class include lakeside marshes and nearly level peatlands surrounding lacustrine waters.

Lacustrine fringe wetlands are not present in the Donlin Gold project area west of the PSA corridor because there are no large waterbodies that meet the size or depth requirement for lacustrine classification. Lacustrine fringe wetlands occur sporadically in the PSA corridor, mostly in the eastern half of the corridor. Examples include wetlands along the edge of Charlie Lake west of MP139 (see Photograph A.5-1), Rainy Pass Lake southwest of MP117, and an unnamed lake at MP193 (see Photograph A.5-2).

Photograph A.5-1. Lacustrine fringe HGM class bordering Charlie Lake, west of Milepost 139 of the PSA.

Photograph A.5-2. Lacustrine fringe HGM class bordering unnamed lake, Milepost 193 of the PSA.

A.6 Riverine Channel Wetlands

Wetlands and flowing waters contained within a channel are classified as riverine channel wetlands in the HGM system for the Donlin Gold project area. This class includes bare sand and gravel bars, bars that support pioneer vegetation, channel areas with non-persistent emergents or aquatic vegetation (e.g., submerged plants), and unvegetated flowing water. The riverine channel class is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetlands dominated by trees, shrubs, persistent emergents, mosses, or lichens. The adjacent wetlands dominated by persistent vegetation are usually in the riverine wetlands HGM class.

Riverine channel wetlands in the Donlin Gold project area range from very large rivers, such as the Kuskokwim River and the Big River (see Photograph A.6-1), to small unnamed hillside creeks. While most channels are perennial, some flow for only part of the year (intermittent).

Photograph A.6-1. Big River riverine channel, Milepost 191 of the PSA.

A.7 Lacustrine Waters

Wetlands surrounding lakes that have hydrologic regimes controlled by the water level of the lake water are classified as lacustrine fringe wetlands. The body of water that forms the lake itself is classified as lacustrine in the project HGM system. Unvegetated flats along the lake edge that may become exposed during periods of low water are also considered to be in this HGM class. These water areas must be 20 acres or larger in size, or at least 2 meters in depth in the deepest part of the basin. The size and depth requirements follow the definition of the lacustrine ecological system in the *Classification of Wetlands and Deepwater Habitats of the U.S.* (Cowardin et al. 1979).

Lacustrine waters are not present in the FSA portion of the Donlin Gold project area because there are no large waterbodies that meet the size or depth requirement for lacustrine classification. Lacustrine waters occur sporadically in the PSA corridor, mostly in the eastern half. Examples include Charlie Lake west of MP139 (see Photograph A.7-1), Rainy Pass Lake southwest of MP117, and an unnamed lake at MP90.

Photograph A.7-1. Lacustrine, Charlie Lake, west of Milepost 139 of the PSA.

Appendix B

Descriptions and Matrices for Magee Wetland Functions for the Donlin Gold Project

This appendix provides complete descriptions and model matrices for each of the eight functions performed by wetlands found within the Donlin Gold project area. The section also includes a wetland example from the project area for each function. The variables (e.g., soil type, frequency of overbank flooding, and vegetation density) included in the matrices and examples are described in Appendix C.

B.1 Modification of Groundwater Discharge

Description of Function

Modification of groundwater discharge is the capacity of a wetland to influence the amount of water moving from groundwater to surface water. This function is performed primarily by riverine and slope wetlands in the Donlin Gold project area, and to a lesser degree by flats and depressional wetlands. Many wetlands modify the amount and rate of groundwater discharging from the underlying aquifer into and through the wetland when the wetland is in a discharge flow condition. Groundwater under and in wetlands may occur in one of three flow conditions: discharge (upward movement), recharge (downward movement), or horizontal flow (Magee and Hollands 1998). Factors that influence a wetland's ability to perform the modification of groundwater discharge function include soil type, wetland water régime, the surficial geologic deposit under the wetland, the relationship of the wetland to the regional piezometric surface, and the presence of seeps and springs.

Riverine areas are predominantly groundwater discharge areas, where regional groundwater discharges into the floodplain wetlands and/or the river channel. In Alaska, seeps and springs are common at the floodplain edges along the base of bordering bluffs. In addition, slope wetland complexes commonly adjoin floodplains and release groundwater into the riverine systems. These complexes are especially common in the portion of the Donlin Gold project area in the Cook Inlet Basin ecoregion where they often occur as expansive fens bisected by permanently flowing streams.

Slope wetlands are predominantly areas of groundwater discharge where the water table intersects with the land's surface. In these wetlands, water is discharged at the uppermost portions of the wetland, flows through the wetland, and often recharges in more permeable material below the lower end of the slope system.

Model Matrix

Table B-1.1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for modification of groundwater discharge. This model may be applied to both year-long and seasonal discharge wetlands.

Table B-1.1
Modification of Groundwater Discharge: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope	Depressional	Flats	Lacustrine Fringe[a]
Indicators of Dysfunction[b,c]						
Inlet/Outlet Class (Vinout)	perennial inlet/no outlet	0	0	0	0	NA
Nested Piezometer Data (Vnespiez)	recharge condition	0	0	0	0	NA
Relationship to Regional Piezometric Surface (Vregpiez)	wetland substrate elevation above piezometric surface	0	0	0	0	NA
Direct Indicators of Function[c,d]						
Inlet/Outlet Class (Vinout)	no inlet/perennial outlet	15	15	18	18	NA
Presence of Springs and Seeps (Vsep-spr)	evidence of perennial seeps or springs	15	15	18	18	NA
Nested Piezometer Data (Vnespiez)	discharge condition	15	15	18	18	NA
Relationship to Regional Piezometric Surface (Vregpiez)	wetland substrate elevation below piezometric surface	15	15	18	18	NA
Primary Variables						
Microrelief of Wetland	pronounced	3	3	3	3	NA
Surface (Vmicro)	well developed	2	2	2	2	NA
	poorly developed	1	1	1	1	NA
	absent	0	0	0	0	NA
Inlet/Outlet Class (Vinout)	perennial inlet/perennial outlet	0	3	3	3	NA
	intermittent inlet/perennial outlet	0	2	2	2	NA
	all other classes	0	0	0	0	NA

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe[a]
pH (VpH)	alkaline	3	3	3	3	NA
	circumneutral	2	2	2	2	NA
	acid	0	0	0	0	NA
	no water present	0	0	0	0	NA
Surficial Geologic Deposit Under Wetland	high permeability stratified deposits	3	3	3	3	NA
(Vsurgeo)	low permeability stratified deposits	2	2	2	2	NA
	glacial till	1	1	1	1	NA
Wetland Water Regime (Vregm)	wet: permanently flooded, semipermanently flooded	3	0	3	3	NA
	drier: seasonally flooded, temporarily flooded, saturated	1	0	1	1	NA
Soil Type	histosol	3	3	3	3	NA
(Vsoil)[e]	mineral hydric soil	1	1	1	1	NA
Model Range		**3-15**	**2-15**	**3-18**	**3-18**	
Functional Capacity Index Range		**0.22-1.0**	**0.16-1.0**	**0.19-1.0**	**0.19-1.0**	

Notes:

a. The function modification of groundwater discharge is not applicable to the lacustrine fringe HGM class.

b. If any indicators of dysfunction are present then FCI = 0.

c. If no direct indicators of function or indicators of dysfunction are present then:

FCI = (Vmicro + Vinout + VpH + Vsurgeo + Vregm + Vsoil) / 6 for depressional and flats wetlands.

FCI = (Vmicro + Vinout + VpH + Vsurgeo + Vsoil) / 5 for slope wetlands.

FCI = (Vmicro + VpH + Vsurgeo + Vregm + Vsoil) / 5 for riverine wetlands.

d. If any direct indicators of function are present then FCI = 1.

e. If the soil is a mineral soil with a histic epipedon, the score is the average of the weights for the mineral and histic components. If the average is not a whole number, it is rounded up to the nearest whole number (e.g., 1.5 is rounded up to 2.0).

Example of Modification of Groundwater Discharge

Figure B-1.1 shows a wetland on a footslope landform with no inlet and no outlet. The HGM class for this wetland is slope. Table B-1.2 provides variable scores for the wetland shown in Figure B-1.1 (plot 3PP4136).

Figure B-1.1
Plot 3PP4136, Crevice Creek Watershed

Table B-1.2
Variables Scores for Wetland at Plot 3PP4136, Crevice Creek Watershed

Variable	Condition	HGM Class - Slope
Microrelief of Wetland Surface (Vmicro)	pronounced	3
Inlet/Outlet Class (Vinout)	no inlet/no outlet	0
pH (VpH)	circumneutral	2
Surficial Geologic Deposit under Wetland (Vsurgeo)	low permeability stratified deposits	2
Soil Type (Vsoil)	Mineral soil with histic epipedon	2
Total Variable Score		**9**
Functional Capacity Index[a]		**0.60**

Note:

a. FCI is calculated by dividing the total wetland variable score of 9 by the maximum possible score (3 per variable, or 15) for an FCI of 0.60: 9 / 15 = 0.60.

B.2 Modification of Groundwater Recharge

Description of Function

Modification of groundwater recharge is the capacity of a wetland to influence the amount of water moving from surface water to groundwater. In wetlands in a recharge condition, accumulated surface water and precipitation move through the wetland into the underlying groundwater system (Magee and Hollands 1998). For many wetlands, the recharge likely occurs at the edge of the wetland. This is because the soils under most wetlands are less permeable than better-drained surrounding non-wetland areas. Therefore, recharge appears to be relatively more important in small wetlands where the edge-to-volume ratio is high (Mitsch and Gosselink 1986).

Most wetlands that are not in a discharge condition have the ability to recharge the underlying groundwater. Even perched wetlands may recharge an aquifer by slow seepage. The only absolute means of determining the hydrologic condition of a wetland is by the use of nested piezometers monitored for at least 1 year to determine differences in hydraulic head beneath the wetland.

The modification of groundwater recharge function is applicable to flats, lacustrine fringe, depressional, and riverine wetlands in the Donlin Gold project area. In areas underlain by permafrost, the function is less likely to occur than in areas where permafrost is absent. Permafrost occurs most commonly in areas classified as flats HGM wetlands. While riverine systems in Alaska are predominantly groundwater discharge areas, there are some areas where recharge occurs. While obvious recharge sites can be seen where flowing channels become dry over a short distance, other recharge locations can only be confirmed where nested piezometer data establishes a recharge condition.

Wetland characteristics and processes that influence the modification of groundwater recharge function include the ability of the surface of the wetland to hold water in low topographic relief areas, the permeability of soil and subsurface geology, land use modifications to the wetland or upslope areas that directly or indirectly affect recharge rate (e.g., soil compaction), and the wetland water regime.

Model Matrix

Table B-2.1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for modification of groundwater recharge. This model may be applied to both year-long and seasonal recharge wetlands.

Table B-2.1
Modification of Groundwater Recharge: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope[a]	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction[b]						
Inlet/Outlet Class (Vinout)	no inlet/perennial outlet; intermittent inlet/perennial outlet	-	NA	0	0	-
Nested Piezometer Data (Vnespiez)	discharge condition	0	NA	0	0	0
Relationship to Regional Piezometric Surface (Vregpiez)	wetland substrate elevation above or at piezometric surface	0	NA	0	0	0
Presence of Seeps and Springs	presence of seeps or springs	0	NA	0	0	0
Direct Indicators of Function[c]						
Inlet/Outlet Class (Vinout)	perennial inlet/no outlet	-	NA	21	21	-
Nested Piezometer Data (Vnespiez)	recharge condition	-	NA	21	21	-
Relationship to Regional Piezometric Surface (Vregpiez)	wetland substrate elevation below piezometric surface	-	NA	21	21	-
Primary Variables						
Microrelief of Wetland Surface (Vmicro)	poorly developed	3	NA	3	3	3
	absent	3	NA	3	3	3
	well developed	2	NA	2	2	2
	pronounced	1	NA	1	1	1
Inlet/Outlet Class (Vinout)	perennial inlet/intermittent outlet	0	NA	3	3	0
	all other classes	0	NA	0	0	0

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope[a]	Depressional	Flats	Lacustrine Fringe
pH (VpH)	acid	3	NA	3	3	3
	circumneutral	2	NA	2	2	2
	alkaline	1	NA	1	1	1
	no water present	0	NA	0	0	0
Surficial Geologic Deposit Under Wetland (Vsurgeo)	glacial till	1	NA	3	3	1
	low permeability stratified deposits	2	NA	2	2	2
	high permeability stratified deposits	3	NA	1	1	3
Surface Water Level Fluctuation (Vsurwat)	high fluctuation	3	NA	3	3	3
	low fluctuation	2	NA	2	2	2
	never inundated	1	NA	1	1	1
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3	NA	3	3	3
	wet: permanently flooded, semipermanently flooded	1	NA	1	1	1
Soil Type (Vsoil)[d]	gravelly or sandy mineral hydric	3	NA	3	3	3
	silty or clayey mineral hydric	2	NA	2	2	2
	sapric histosol	1	NA	1	1	1
	fibric or hemic histosol	0	NA	0	0	0
Model Range		**4-18**		**4-21**	**4-21**	**4-18**
Functional Capacity Index Range		**0.22-1.0**		**0.19-1.0**	**0.19-1.0**	**0.22-1.0**

Notes:

a. The function modification of groundwater recharge is not applicable to the slope HGM class.

b. If any indicators of dysfunction are present then FCI = 0.

c. If no direct indicators of function are present then:

FCI = (Vmicro + VpH + Vsurgeo + Vsurwat + Vregm + Vsoil) / 18 for lacustrine fringe and riverine wetlands.

FCI = (Vmicro + Vinout + VpH + Vsurgeo + Vsurwat + Vregm + Vsoil) / 21 for depressional and flats wetlands.

d. If the soil is a mineral soil with a histic epipedon, the score is the average of the weights for the mineral and histic components. If the average is not a whole number, it is rounded up to the nearest whole number (e.g., 1.5 is rounded up to 2.0).

Example of Modification of Groundwater Recharge

Figure B-2.1 shows a wetland on a hillside landform with no inlet and no outlet. The HGM class for this wetland is flats. Table B-2.2 shows the variable scores for the wetland shown in Figure B-2.1 (plot 3PP13389).

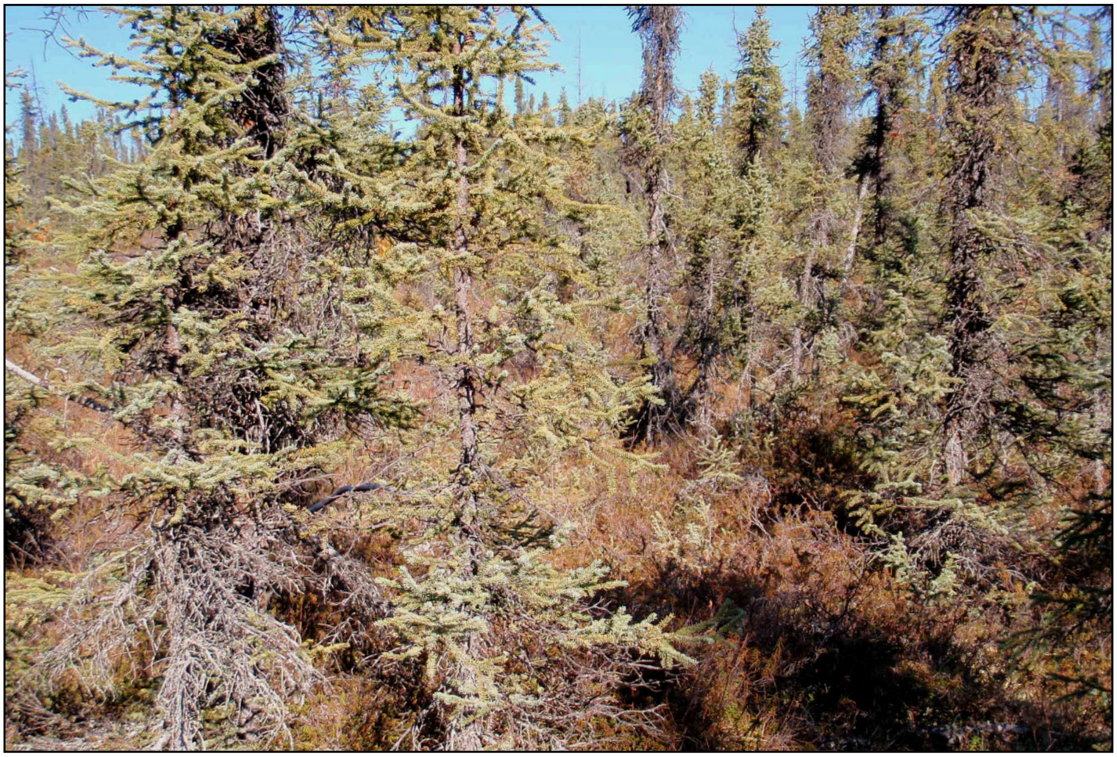


Figure B-2.1
Plot 3PP13389, American Creek Watershed

Table B-2.2
Variables Scores for Wetland at Plot 3PP13389, American Creek Watershed

Variable	Condition	HGM Class - Flats
Microrelief of Wetland Surface (Vmicro)	well developed	2
Inlet/Outlet Class (Vinout)	no inlet/no outlet	0
pH (VpH)	no water present	0
Surficial Geologic Deposit Under Wetland (Vsurgeo)	low permeability stratified deposits	2

Variable	Condition	HGM Class - Flats
Surface Water Level Fluctuation (Vsurwat)	never inundated	1
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3
Soil Type (Vsoil)	silty or clayey mineral hydric with a fibric histic epipedon	2
Total Variable Score		**9**
Functional Capacity Index[a]		**0.43**

Note:

a. FCI is calculated by dividing the total wetland variable score of 9 by the maximum possible score (3 per variable, or 21) for an FCI of 0.43: 9 / 21 = 0.43.

B.3 Storm and Floodwater Storage

Description of Function

The storm and floodwater storage function is a measure of the capacity of the wetlands to store inflowing water from storm events or flooding events, resulting in detention or retention of water on the wetland surface (Magee and Hollands 1998). This function is applicable to all the primary HGM wetland classes in the Donlin Gold project area. Wetlands have the capacity to receive and retain surface and shallow subsurface water, the amounts of which are dependent on the position of the water table, soil moisture regime, permafrost, other restrictive layers, surface roughness, slope, vegetation density, inlets and outlets, and the position of the wetlands within the watershed. Wetlands within the project area characteristically store surface and near-surface water within surface relief features, organic soil horizons, and salty or loamy mineral horizons. While riverine wetlands are usually the only wetlands class that receive and store overbank flooding from rivers and streams, the other classes (e.g., slope, flats, and depressional) provide storm and floodwater storage of direct precipitation, groundwater discharge, and through-flowing runoff. The storage of surface waters from storm events or flooding events at any point within the watershed ultimately reduces peak flood stages of the downstream drainage system.

In riverine wetlands, this function is primarily associated with detaining moving water from overbank flow. However, the function also addresses the temporary storage of surface water inputs into floodplains by overland flow, groundwater discharge, direct precipitation, or tributaries. The movement of water through a wetland during an overbank flow event is controlled by width, slope, and roughness of the area inundated (Brinson et al. 1995). The longer water is detained as it moves through a wetland of any HGM class, the greater the potential for the wetlands to perform the function and to support other wetland functions. Storm and floodwater storage influences energy dissipation, reduces and delays downstream peak flows, reduces sediment delivery downstream, improves surficial groundwater recharge, and improves water quality. Reduced peak flows and reduced sediment delivery maintain characteristic channel dynamics downstream.

The Donlin Gold project area spans a diverse region of Alaska, including permafrost-driven areas of Alaska's interior, mountain valleys and slopes of the Alaska Range, and the more temperate coastal areas of the Cook Inlet. Examples of this function being performed in wetlands throughout the diverse study area include the following:

- Flats HGM wetland types in the permafrost-controlled wetlands of Alaska's interior store surface and near-surface water within microtopographic relief features such as tussocks and hummocks, and within typically thick organic soil horizons.
- Slope wetlands throughout the project area are often found within swale features and at the toes of slopes where they intersect groundwater discharge and retain water through surface roughness including hummocks, dense ground vegetation, and organic soil horizons. Large, string bog complexes are found in the Cook Inlet area of the project and retain surface waters through a diverse microtopographic relief complex of large hummocks and depressions that intercept groundwater discharge and direct precipitation.
- Floodwater storage is observable during peak flow periods in riverine wetlands occurring on wide floodplains along lower-gradient rivers such as Crooked Creek in the Kuskokwim Mountains ecoregion and Middle Happy River in the Alaska Range ecoregion. Storage occurs in depressional features such as abandoned and connected oxbows, as well as in other shallow depressions such as floodplain marshes.

Model Matrix

Table B.3-1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for storm and floodwater storage.

Table B.3-1
Storm and Floodwater Storage: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables		Weights (per HGM Class)				
(Variable Code)	Conditions	Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction						
None	-	-	-	-	-	-
Direct Indicators of Function[a,b]						
Inlet/Outlet Class (Vinout)	no outlet	-	21	27	30	-
Primary Variables						
Inlet/Outlet Class (Vinout)	perennial inlet/intermittent outlet	0	3	3	3	0
	intermittent inlet/intermittent outlet	0	2	2	2	0
	no inlet/intermittent outlet	0	1	1	1	0
	no inlet/perennial outlet	0	1	1	1	0

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
	intermittent inlet/perennial outlet	0	1	1	1	0
	perennial inlet/perennial outlet	0	1	1	1	0
Degree of Outlet Restriction (Vout)	restricted	0	0	3	3	0
	unrestricted	0	0	0	0	0
Basin Topographic Gradient (Vtopo)	low gradient	3	3	3	3	0
	high gradient	1	1	1	1	0
Microrelief of Wetland Surface (Vmicro)	pronounced	3	3	3	3	3
	well developed	2	2	2	2	2
	poorly developed	1	1	1	1	1
	absent	0	0	0	0	0
Frequency of Overbank Flooding (Vfreq)	return interval of 1-2 years	3	0	0	3	3
	return interval of 2-5 years	2	0	0	2	2
	return interval of >5 years	1	0	0	1	1
	overbank flooding absent	0	0	0	0	0
Vegetation Density Dominance (Vvegden)	high/very high	3	3	3	3	3
	moderate	2	2	2	2	2
	sparse/low	1	1	1	1	1
	no vegetation	0	0	0	0	0
Surface Water Level Fluctuation (Vsurwat)	high fluctuation	3	0	3	3	3
	low fluctuation	2	0	2	2	2
	never inundated	0	0	0	0	0
Ratio of Wetland Area to Watershed Area (Varea)	large	3	3	3	3	3
	small	1	1	1	1	1

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3	3	3	3	3
	wet: permanently flooded, semi-permanently flooded	1	1	1	1	1
Dead Woody Material (Vwood)	abundant	3	3	3	3	3
	moderately abundant	2	2	2	2	2
	low abundance	1	1	1	1	1
Model Range		**3-24**	**4-21**	**4-27**	**4-30**	**2-21**
Functional Capacity Index Range		**0.12-1.0**	**0.19-1.0**	**0.15-1.0**	**0.13-1.0**	**0.09-1.0**

Notes:

a. If direct indicator of function is present in depressional, slope, and flats wetlands, then FCI = 1.

b. If no direct indicator of function is present then:

FCI = (Vinout + Vout + Vtopo + Vmicro + Vfreq + Vvegden + Vsurwat + Varea + Vregm + Vwood) / 30 for flats wetlands.

FCI = (Vtopo + Vmicro + Vfreq + Vvegden + Vsurwat + Varea + Vregm + Vwood) / 24 for riverine wetlands.

FCI = (Vmicro + Vfreq + Vvegden + Vsurwat + Varea + Vregm + Vwood) / 21 for lacustrine fringe wetlands.

FCI = (Vinout + Vtopo + Vmicro + Vvegden + Varea + Vregm + Vwood) / 21 for slope wetlands.

FCI = (Vinout + Vout + Vtopo + Vmicro + Vvegden + Vsurwat + Varea + Vregm + Vwood) / 27 for depressional wetlands.

Example of Storm and Floodwater Storage

Figure B.3-1 shows a wetland on a floodplain landform with an intermittent inlet and an intermittent outlet. The HGM class for this wetland is riverine. Table B.3-2 shows variable scores for the wetland shown in Figure B.3-1 (plot 3PP13802).

Figure B.3-1
Plot 3PP13802, Sevenmile Lake Watershed

Table B.3-2
Variable Scores for Wetland at Plot 3PP13802, Sevenmile Lake Watershed

Variable	Condition	HGM Class - Riverine
Basin Topographic Gradient (Vtopo)	low	3
Microrelief of Wetland Surface (Vmicro)	well-developed	2
Frequency of Overbank Flooding (Vfreq)	return interval of 1-2 years	3
Vegetation Density Dominance (Vvegden)	very high	3
Surface Water Level Fluctuation (Vsurwat)	low fluctuation	2
Ratio of Wetland Area to Watershed Area (Varea)	small	1
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3
Dead Woody Material (Vwood)	low abundance	1
Total Variable Score		**18**
Functional Capacity Index[a]		**0.75**

Note:

a. FCI is calculated by dividing the total wetland variable score of 18 by the maximum possible score (3 per variable, or 24) for an FCI of 0.75: 18 / 24 = 0.75.

B.4 Modification of Stream Flow

Description of Function

Modification of stream flow is a measure of the wetland's capacity to physically influence the inflow hydrology and to produce the outlet stream's hydrology (Magee and Hollands 1998). The inflow hydrology (all water entering the wetland) is modified by the wetland's characteristics, composition, and processes including vegetation, soil, and hydraulic interactions. This function is directly related to a wetland's capacity to retain and detain storm and flood waters as well as its capacity to receive groundwater discharge. As a result, this function combines the outputs of the storm and floodwater storage function and the modification of groundwater discharge function. Wetland soils that modify groundwater discharge through retention and detention will influence the outlet stream's base flow portion of its hydrograph. Wetland gradient, microrelief features, vegetation, and outlet constriction contribute to retention and detention of inflowing water, which contributes to the storm flow portion of the outlet stream's hydrograph. This function also refers to the general hydrologic connectivity of a wetland to all downgradient systems including other wetlands.

The modification of stream flow function is performed primarily by slope and riverine wetlands in the Donlin Gold project area, and to a lesser degree by flats, depressional, and lacustrine fringe wetlands. In the Donlin Gold project area, riverine systems are often bounded by slope wetlands or connected to the slope wetlands by small streams. These slope wetlands are a major source of groundwater discharge, which maintains stream base flow and, therefore, slope wetlands are important for providing hydrologic support for downstream receiving waters. This is particularly the case in portions of the Cook Inlet basin ecoregion where expansive fen complexes are bisected by permanently flowing streams that provide critical base flow to downsteam river systems.

Riverine wetlands modify the rate, stage, and volume of stream flow within the river channel by intercepting overbank and seasonal channel flood waters. Water entering riverine wetlands from non-channel sources such as seeps, springs, or overland flow is also retained or detained within the wetlands prior to entering the river channel. These processes reduce and delay storm peak flows, reduce sediment deposition within the channel, and ultimately maintain a dynamic equilibrium of sediment characteristic of the channel.

Model Matrix

Table B.4-1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for modification of stream flow.

Table B.4-1
Modification of Stream Flow: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables[a]

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction[b]						
Inlet/Outlet Class (Vinout)	no outlet	0	0	0	0	0

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Direct Indicators of Function						
None	-	-	-	-	-	-
Primary Variables						
Storm and Flood Water Storage Function Model Score[c]		Multiplier	Modification of Groundwater Discharge Function Model Score[c]			Multiplied Results
High	3	X	High	3	=	9
Mod	2	X	High	3	=	6
Low	1	X	High	3	=	3
High	3	X	Mod	2	=	6
Mod	2	X	Mod	2	=	4
Low	1	X	Mod	2	=	2
High	3	X	Low	1	=	3
Mod	2	X	Low	1	=	2
Low	1	X	Low	1	=	1
Model Range		**1-9**	**1-9**	**1-9**	**1-9**	**1-9**
Functional Capacity Index Range		**0.11-1.0**	**0.19-1.0**	**0.11-1.0**	**0.11-1.0**	**0.11-1.0**

Notes:

a. The model for this function is a combination of the model results for the storm and floodwater storage and modification of groundwater discharge functions. This model is identical for all HGM classes.

b. If an indicator of dysfunction is present, then FCI = 0. If no indicator of dysfunction is present, then FCI = (Storm and Floodwater Storage score x Modification of Groundwater Discharge score) / 9.

c. High = FCI of 0.67-1.0; Mod = FCI of 0.34-0.66; Low = FCI of 0-0.33 for the storm and flood Water storage and modification of groundwater discharge function model scores.

Example of Modification of Stream Flow

Figure B.4-1 shows a wetland on a floodplain landform with an intermittent inlet and intermittent outlet. The HGM class for this wetland is riverine. Table B.4-2 shows variable scores for the wetland shown in Figure B.4-1 (plot 3PP1110).

Figure B.4-1
Plot 3PP1110, Kuskokwim River Watershed

Table B.4-2
Variable Scores for Wetland at Plot 3PP1110, Kuskokwim River Watershed

FCI for Storm and Floodwater Storage	Score	FCI for Modification of Groundwater Discharge	Score	Score for Modification of Stream Flow[a]
0.88	3	1.0	3	9
Total Variable Score				9
Functional Capacity Index (FCI)[b]				**1.0**

Notes:

a. Modification of stream flow score is the result of multiplying the scores for storm and floodwater storage and modification of groundwater discharge.

b. FCI is calculated by dividing the total wetland variable score of 9 by the maximum possible score (9) for an FCI of 1.0: 9 / 9 = 1.0.

B.5 Modification of Water Quality

Description of Function

Modification of water quality is a measure of the wetland's capacity to remove suspended and dissolved solids from surface water and dissolved solids from groundwater and to convert them into other forms, plant or animal biomass, or gases (Magee and Hollands 1998). Elements that may be removed or sequestered include macronutrients essential to plant growth (primarily nitrogen and phosphorus), and heavy metals (e.g., arsenic, lead, and zinc) that can be toxic to many life forms at high concentrations. Compounds include pesticides, oils, salts, and dissolved organic compounds. Particulates include geologic and accelerated erosional sediments and organic matter (Hauer et al. 2002).

Water may enter the wetland by means of surface inflow, groundwater discharge, or precipitation and be discharged with a different chemistry as a result of passing through the wetland (Kadlec and Kadlec 1979, Clausen and Johnson 1990, Simmons et al. 1992, Groffman et al. 1991, Lowrance et al. 1984). Debris and suspended solids may be removed by physical processes such as filtering and sedimentation. Nutrients, dissolved solids, and other constituents may be broken down, degraded, or removed such that they become inactive or are incorporated into biomass. There are several ways in which this may occur, including adsorption and absorption by soil particles, uptake by vegetation, and loss to the atmosphere. Other mechanisms of removal include sorption, denitrification, burial, decomposition to inactive forms, uptake, and incorporation into long-lasting woody and long-lived perennial herbaceous biomass and similar processes (Brinson et al. 1995).

All five primary HGM wetland classes in the Donlin Gold project area have the potential to perform the modification of water quality function. Performance of this function is usually proportional to residence time of water in the wetland and flow characteristics (i.e., sheet flow versus channelized flow) and vegetation community structure (Kadlec and Kadlec 1979). Other factors that influence the performance include hydraulic outlets, gradient, microrelief of the wetland surface, and soil type.

In order for wetlands to modify water quality by removing imported elements, compounds, and sediment, they must first be transported to the wetland. Riverine HGM wetland types have the potential to receive overbank flood waters from streams and rivers, and by reducing water velocities through surface roughness are able to retain sediment and other particulates. Slope HGM wetland types, as well as some depressional HGM wetland types, typically receive groundwater discharge and surface runoff and provide the opportunity to perform this function through surface roughness, biomass uptake, and dynamic soil moisture regimes. Absent overbank flood waters and groundwater discharge, opportunity for flats HGM wetlands, as well as some depressional HGM wetlands, to carry out this function is limited to those elements and compounds introduced by way of direct precipitation and intercepting overland runoff.

Model Matrix

Table B.5-1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for modification of water quality.

Table B.5-1
Modification of Water Quality: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction						
	none	-	-	-	-	-
Direct Indicators of Function[a]						
Evidence of Sedimentation (Vsed)	evidence of sedimentation	12	15	18	18	12
Primary Variables						
Wetland Land Use (Vwetuse)	low intensity	3	3	3	3	3
	moderate intensity	2	2	2	2	2
	high intensity	1	1	1	1	1
Degree of Outlet Restriction (Vout)	restricted	0	0	3	3	0
	no outlet	0	0	2	2	0
	unrestricted	0	0	1	1	0
Inlet/Outlet Class (Vinout)	no outlet	0	3	3	3	0
	intermittent outlet	0	2	2	2	0
	perennial outlet	0	1	1	1	0
Dominant Wetland Type (Vtype)	forested wetland	3	3	3	3	3
	scrub-shrub	2	2	2	2	2
	emergent wetland	2	2	2	2	2
	aquatic bed	0	0	1	0	0
	no vegetation	0	0	0	0	0
Cover Distribution (Vcover)	forming a continuous cover	3	3	3	3	3
	growing in small scattered patches	2	2	2	2	2
	one of more large patches	1	1	1	1	1
	solitary scattered stems	1	1	1	1	1
	no vegetation	0	0	0	0	0
Soil Type (Vsoil)[b]	histosol or clayey soil	3	3	3	3	3
	silty soil	2	2	2	2	2
	sandy or gravelly soil	1	1	1	1	1

Variables (Variable Code)	Conditions	Weights (per HGM Class) Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Model Range		**2-12**	**3-15**	**4-18**	**4-18**	**2-12**
Functional Capacity Index Range		**0.16-1.0**	**0.20-1.0**	**0.22-1.0**	**0.22-1.0**	**0.16-1.0**

Notes:

a. If a direct indicator of function is present, then FCI = 1. If no direct indicator of function is present, then:
FCI = (Vwetuse + Vout + Vinout + Vtype + Vcover + Vsoil) / 18 for depressional and flats wetlands
FCI = (Vwetuse + Vinout + Vtype + Vcover + Vsoil) / 15 for slope wetlands
FCI = (Vwetuse + Vtype + Vcover + Vsoil) / 12 for lacustrine fringe and riverine wetlands

b. If the soil is a mineral soil with a histic epipedon, the score is the average of the weights for the mineral and histic components. If the average is not a whole number, it is rounded up to the nearest whole number (e.g., 1.5 is rounded up to 2.0).

Example of Modification of Water Quality

Figure B.5-1 shows a wetland on a bench landform with a perennial inlet and perennial outlet. The HGM class for this wetland is depressional. Table B.5-2 shows variable scores for the wetland shown in Figure B.5-1 (plot 3PP1570).

Figure B.5-1
Plot 3PP1570, Crooked Creek Watershed

Table B.5-2
Variable Scores for Wetland Assessed at Plot 3PP1570, Crooked Creek Watershed

Variable	Condition	HGM Class - Depressional
Wetland Land Use (Vwetuse)	low intensity	3
Degree of Outlet Restriction (Vout)	unrestricted	1
Inlet/Outlet Class (Vinout)	perennial outlet	1
Dominant Wetland Type (Vtype)	emergent wetland	2
Cover Distribution (Vcover)	growing in small scattered patches	2
Soil Type (Vsoil)	histosol	3
Total Variable Score		**12**
Functional Capacity Index[a]		**0.67**

Note:

a. FCI is calculated by dividing the total wetland variable score of 12 by the maximum possible score (3 per variable, or 18) for an FCI of 0.67: 12 / 18 = 0.67.

B.6 Export of Detritus

Description of Function

The export of detritus function refers to the transfer of dissolved and particulate organic carbon from the wetland to adjacent and downstream aquatic ecosystems. Mechanisms include leaching, flushing, displacement, and erosion.

Two factors are required for a wetland to be a source of organic carbon for export: a source of organic matter and water flow (a transport mechanism). Water flow has two components: water sources and surface hydraulic connections. Surface connections between the wetlands and downgradient systems (e.g., stream channels or other wetlands) are essential for providing a pathway assuring that export actually occurs. If either organic carbon is absent or surface hydraulic connections are lacking (i.e., the wetland is diked or otherwise isolated), the function is lacking (Brinson et al. 1995). For example, depressional wetlands lacking an outlet have little or no opportunity to perform the export of detritus function. Closed depressions such as this are common in a few areas along the Donlin Gold PSA.

All HGM wetland classes in the Donlin Gold project area have the potential to perform the export of detritus function. However, this function is much more likely to occur in slope and riverine wetlands due to the common occurrence of outlets that provide a pathway for export. Many slope wetlands in the project area in toeslope positions, drainages, and broad slope complexes contain these outlet streams. While large amounts of detritus are produced in flats wetlands, these areas have much less opportunity to export detritus because they are intersected by fewer streams. However, some flats wetlands have discharge streams along their periphery. Other wetland characteristics that affect a wetland’s ability to perform this function include water regime, vegetation density, soil type, and the land use of the wetland.

Model Matrix

Table B.6-1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for export of detritus.

Table B.6-1
Export of Detritus: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction[a,b]						
Inlet/Outlet Class (Vinout)	no outlet	-	0	0	0	-
Direct Indicators of Function						
	none	-	-	-	-	-
Primary Variables						
Wetland Land Use	moderate intensity	3	3	3	3	3
(Vwetuse)	low intensity	2	2	2	2	2
	high intensity	1	1	1	1	1
Degree of Outlet	unrestricted	0	0	3	3	0
Restriction (Vout)	restricted	0	0	1	1	0
Inlet/Outlet Class	perennial outlet	0	3	3	3	0
(Vinout)	intermittent outlet	0	1	1	1	0
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3	3	3	3	3
	wet: permanently flooded, semipermanently flooded	1	1	1	1	1
Vegetation Density/	high/very high	3	3	3	3	3
Dominance	medium	2	2	2	2	2
(Vvegden)	sparse/low	1	1	1	1	1
	no vegetation	0	0	0	0	0
Soil Type (Vsoil)[1]	mineral hydric soil	3	3	3	3	3
	histosol	1	1	1	1	1
Model Range		**3-12**	**4-15**	**5-18**	**5-18**	**3-12**
Functional Capacity Index Range		**0.25-1.0**	**0.26-1.0**	**0.27-1.0**	**0.27-1.0**	**0.25-1.0**

Notes:

a. If any indicators of dysfunction are present in depressional, slope, and flats wetlands, then FCI = 0.

b. If no indicators of dysfunction are present then:

FCI = (Vwetuse + Vout + Vinout + Vregm + Vvegden + Vsoil) / 18 for depressional and flats wetlands.

FCI = (Vwetuse + Vinout + Vregm + Vvegden + Vsoil) / 15 for slope wetlands.

FCI = (Vwetuse + Vregm + Vvegden + Vsoil) / 12 for lacustrine fringe and riverine wetlands.

c. If the soil is a mineral soil with a histic epipedon, the score is the average of the weights for the mineral and histic components. If the average is not a whole number, it is rounded up to the nearest whole number (e.g., 1.5 is rounded up to 2.0).

Example of Export of Detritus

Figure B.6-1 shows an open willow shrub wetland on a floodplain landform with an intermittent inlet and an intermittent outlet. The HGM class for this wetland is riverine. Table B.6-2 shows variable scores for the wetland shown in Figure B.6-1 (plot 3PP1231a).

Figure B-6.1
Plot 3PP1231a, Anaconda Creek Watershed

Table B-6.2
Variables Scores for Wetland at Plot 3PP1231a, Anaconda Creek Watershed

Variable	Condition	HGM Class - Riverine
Wetland Land Use (Vwetuse)	low intensity	2
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	3
Vegetation Density/ Dominance (Vvegden)	very high	3
Soil Type (Vsoil)	mineral hydric soil	3

Variable	Condition	HGM Class - Riverine
Total Variable Score		**11**
Functional Capacity Index[a]		**0.92**

Note:

a. FCI is calculated by dividing the total wetland variable score of 11 by the maximum possible score (3 per variable, or 12) for an FCI of 0.92: 11 / 12 = 0.92.

B.7 Contribution to Abundance and Diversity of Wetland Vegetation

Description of Function

Contribution to abundance and diversity of wetland vegetation addresses the capacity of a wetland to "produce an abundance and diversity of hydrophytic plant species individually or as part of a group of wetlands in a local landscape" (Magee and Hollands 1998). The calculation used to determine the level of performance of this function is identical for all wetland HGM classes and is based on evaluation of three variables: plant species diversity, vegetation density/dominance, and wetland juxtaposition. These variables are defined in detail in Appendix C. Wetlands with the following attributes are considered to perform this function at maximum level: vegetation occupies at least 80 percent of the wetland area, a minimum of 19 vascular species inhabit the wetland, and the wetland is connected to other wetlands positioned upslope and downslope. Wetlands with less vegetation density, less vegetation diversity, or a greater degree of isolation are considered to perform this function at a diminished level. Wetlands with no vegetation do not perform this function regardless of connectivity to other wetlands. In general, unaltered vegetated wetlands in the Donlin Gold project area score well in this function.

Wetlands are common in the Donlin Gold project area, accounting for approximately 40.7 percent of the total acreage. Thus, most wetlands abut other wetlands, and the variable wetland juxtaposition is generally scored high excepting wetlands that are located at the extreme upslope or downslope ends of a contiguous tract of wetlands. Vegetation density/dominance also is often scored high in unaltered wetlands in the Donlin Gold project area, unless open water is included within the wetland. Multiple layers of vegetation, e.g., mosses with overhanging herbs, shrubs, and/or trees, are common in unaltered wetlands in this region and patches of bare earth are uncommon. Over half of the wetland acreage in the Donlin Gold project area is characterized as forested or as forest scrub. Together, these two vegetation categories account for 64 percent of the total wetland area mapped in the project area (3PPI 2014a). Deciduous shrub or deciduous herb/shrub wetlands are the second most abundant category (31 percent), followed by herbaceous wetlands (5 percent). Due to overlapping vegetation, the average cumulative cover values of vegetation exceeds 150 percent in herbaceous, shrub, or forested wetlands, including recently burned spruce wetlands (160, 197, 205, and 157 percent, respectively).

Scoring of the third variable, plant species diversity, is less consistent across the project area. Vegetation diversity is generally higher in wetland/upland mosaics or in wetlands that include transitional areas between significant changes in abiotic conditions, such as wetland versus upland, and floodplain versus toeslope landscape positions; between structural categories, such as forested and shrub-dominated wetlands; and/or between areas of dissimilar disturbance regime. Plant species diversity is often scored low-to-medium within large stable tracts of spruce forest, alpine shrub tundra, or tussock sedge wetlands. Factors that lead to a loss of wetland connectivity, vegetation density, and/or vegetation diversity will lead to a decrease in this function. These factors may include landscape modifications that diminish wetland abundance, removal of vegetation, loss of landscape complexity, and/or introduction of invasive plant species.

Model Matrix

Table B.7-1 shows the variables and weights for the indicators of dysfunction and the primary variables for contribution to abundance and diversity of wetland vegetation. This model is identical for all HGM classes.

Table B.7-1
Contribution to Abundance and Diversity of Wetland Vegetation: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables[a]

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction[b]						
Vegetation Density/ Dominance (Vvegden)	no vegetation	0	0	0	0	0
Direct Indicators of Function						
	none	-	-	-	-	-
Primary Variables						
Plant Species Diversity (Vdivers)	high diversity	5	5	5	5	5
	medium diversity	3	3	3	3	3
	low diversity	1	1	1	1	1
Vegetation Density/ Dominance (Vvegden)	high/very high	5	5	5	5	5
	medium	3	3	3	3	3
	sparse/low	1	1	1	1	1
Wetland juxta-position (Vjuxta)	connected upstream and downstream	5	5	5	5	5
	connected above or below	3	3	3	3	3
	other wetlands nearby but not connected (400 m or closer)	1	1	1	1	1
	not connected	0	0	0	0	0
Model Range		**2-15**	**2-15**	**2-15**	**2-15**	**2-15**
Functional Capacity Index Range		**0.13-1.0**	**0.13-1.0**	**0.13-1.0**	**0.13-1.0**	**0.13-1.0**

Notes:

a. This model is identical for all HGM classes.

b. If an indicator of dysfunction is present then: FCI = 0. If an indicator of dysfunction is not present then: FCI = (Vdivers + Vvegden + Vjuxta) / 15.

Example of Contribution to Abundance and Diversity of Wetland Vegetation

Figure B.7-1 shows a wetland on a terrace landform that is connected downslope to other wetlands. The vegetation is classified as open black spruce forest – shrub understory. The HGM class for this wetland is flats. Table B.7-2 shows variable scores for the wetland shown in Figure B.7-1 (plot 3PP2045).

Figure B.7-1
Plot 3PP2045, Anaconda Creek Basin

Table B.7-2
Variable Scores for Wetland at Plot 3PP2045, Anaconda Creek Basin[a]

Variables	Conditions	HGM Class - Flats
Plant Species Diversity (Vdivers)	medium diversity	1
Vegetation Density/Dominance (Vvegden)	very high	5
Wetland Juxtaposition (Vjuxta)	connected downstream	3
Total Variables Score		**9**
Functional Capacity Index[a]		**0.60**

Note:

a. FCI is calculated by dividing the total wetland variable score of 9 by the maximum possible score (5 per variable, or 15) for an FCI of 0.60: 9 / 15 = 0.60.

B.8 Contribution to Abundance and Diversity of Wetland Fauna

Description of Function

Contribution to abundance and diversity of wetland fauna (or the wetland fauna function) is the capacity of a wetland to support animal populations and guilds by providing habitats that provide food, cover, and reproductive opportunities. Habitat structure, interspersion, connectivity, and food webs are important components of this wetland function. While wetland habitats provide numerous services for wildlife species, various wildlife populations impact or influence the plant communities through herbivory, nutrient cycling, seed dispersal, and impacting microtopography (ADEC/USACE 1999).

The Magee method uses 12 variables to rate wetlands for this function. Important factors that affect this function include water regime, structure and composition of the vegetation community, juxtaposition to other wetlands, wetland size and interspersion of vegetation cover, and open water. In general, if a wetland is an undisturbed large area that is connected to other wetlands and has well defined, diverse vegetation types with surface water covering at least 25 percent of the area, it will score very high in the Magee method. Small, disturbed, and unconnected wetlands with no surface water and low diversity will score on the low end of the rating scale. Discussion of the wetland fauna function in relation to the HGM classes found in the Donlin Gold project area follows:

- *Flats Wetlands*: Flats wetlands accounted for 24.3 percent of the Donlin Gold project area (3PPI 2013a), and 55.7 percent of the wetlands. Flats wetlands typically included black spruce woodlands and forests, as well as tussock sedge and dwarf birch shrub communities. Permafrost is found under much of these wetlands, maintaining moist soils that provide a consistent substrate for vegetative species found in those communities. The communities, although stable, do not provide much diversity, except in mosaic vegetation patches created by fire. Due to the size of the black spruce forests of Alaska, many species are found to use them (Post 1996); however, they are considered unproductive habitats, especially on mature sites where wildlife species are found in low densities (ADEC/USACE 1999). Scores for the wetland fauna function for flats wetlands tend to be mid-moderate to high.
- *Depressional Wetlands*: Depressional wetlands account for 0.6 percent of the Donlin Gold project area, and 1.3 percent of the wetlands (3PPI 2014a). Depressional wetlands tend to collect and hold water, forming shallow ponds and wet sedge and low shrub bogs. These small open-water ponds with emergent and aquatic vegetation are important to waterfowl, shorebirds, and moose. The willows that tend to grow along the edges are important summer and winter browse for moose, beaver, and muskrat, and provide structural diversity for avian species. These depressions are scattered throughout the black spruce forests, and provide diversity of forage for numerous species.

  Bison in the Farewell burn area are using the depressional wetlands found in the spruce forest that was burned in 2010. Grass and sedge species in open water and saturated soils provide forage, although shrubs also make up a large part of this herd's diet (Waggoner and Hinkes 1985). Numerous bison in these depressions create microtopographic changes through trampling of the wet soils and barren wallows that may provide substrate for colonization by other nearby species (S. Reidsma, personal observation, field plot 3PP16353 [3PPI 2012a]).

Depressional wetlands tend to be small and many times unconnected to other wetlands in the project area. Standing water and higher plant diversity in the vegetated wetlands score higher than ponds with little emergent vegetation.

- *Slope Wetlands*: Slope wetlands account for 13.1 percent of the Donlin Gold project area, and 30.0 percent of the wetlands (3PPI 2014a). Resident time for water is typically low for slope wetlands (Magee and Hollands 1998), thus limiting habitat value for waterfowl. Many of the slope wetlands found in the Donlin Gold project area are also black spruce forests, and as with flats wetlands, are low in habitat value. The slope drainageways and swales that funnel seasonal meltwater host tall willow and alder communities that are important to moose, hares, and other wildlife. A variety of passerine birds nest in tall shrub communities. Species diversity in this habitat is higher than in surrounding spruce forests.

  Slope wetlands tend to form long stringers consisting of tall willow and alder shrubs, starting at the top of hillsides and carrying seasonal or small water-bearing streams downhill and connecting to riverine systems in the lower elevations. This vegetation diversity, connectivity, and small to moderate size produce scores that average mid-moderate to high.

- *Lacustrine/Lacustrine Fringe Wetlands*: Lacustrine and lacustrine fringe wetlands are quite rare in the Donlin Gold project area, comprising less than 289 acres. The open water of the lacustrine lakes and the emergent vegetation of the shorelines (lacustrine fringe) provide good habitat for waterfowl. Open-water feeding as well as cover within the taller sedge and aquatic vegetation provide summer feeding and breeding/nesting areas for numerous waterfowl species. Moose are also attracted to aquatic habitats for the vegetation found along the edges of water. These systems are very stable and provide consistent hydrological presence. The few wetlands evaluated scored mid-moderate to high.

- *Riverine*: Riverine wetlands comprise 3.0 percent of the Donlin Gold project area and 6.9 percent of the wetlands. Riparian vegetation along the floodplains of the rivers and large streams in the project area are consistently flooded, providing stable habitat conditions (Magee and Hollands 1998) and long-connected corridors. Riverine flooding rejuvenates small floodplain ponds, oxbows, and sloughs, which provide good habitat for beaver, muskrat, waterfowl, and shorebirds.

  Moose forage in willow habitats in the floodplains is more plentiful than in other wetland types. Felt-leaf willow (*Salix alaxensis*) is more commonly found in riparian zones than elsewhere on the landscape, and this species is found to be the most favorable winter browse for moose in the interior (Seaton 2002).

  A variety of birds nest in riparian tall shrub communities. Species diversity in this habitat is higher than in surrounding spruce forests.

  - Gray-cheeked Thrush: The gray-cheeked thrush breeds mainly in willow and alder thickets. Open and closed willow and alder communities are important as gray-cheeked thrush habitat.

  - Blackpoll Warbler: The blackpoll warbler breeds in deciduous forest and tall shrub thickets (particularly *Salix alaxensis* and *Alnus incana*). Riparian habitats in western Alaska have been found to have a high density of breeding blackpoll warblers (ADF&G 2006a).

- Shorebirds: Shallow ponds and wetlands interspersed or surrounded by forested habitats are beneficial for both the lesser yellowlegs and the solitary sandpiper. The lesser yellowlegs usually nests in open or semi-open forest interspersed with bogs, ponds, or other wetlands (Tibbitts and Muskoff 1999). The solitary sandpiper usually breeds in muskeg bogs, spruce forests, and deciduous riparian areas (ADF&G 2006b).

The habitat diversity, open water potential, and connectivity of the river systems create higher scores for this function. Mid-moderate to high scores are common.

Model Matrix

Table B.8-1 shows the variables and weights for the indicators of dysfunction, direct indicators of function, and primary variables for contribution to abundance and diversity of wetland fauna.

Table B.8-1
Contribution to Abundance and Diversity of Wetland Fauna: Variables and Weights for Indicators of Dysfunction, Direct Indicators of Function, and Primary Variables

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Indicators of Dysfunction						
	none	-	-	-	-	-
Direct Indicators of Function						
	none	-	-	-	-	-
Primary Variables						
Watershed Land Use (Vsheduse)	low intensity (0-25% urbanized)	3	3	3	3	3
	moderate intensity (25-50% urbanized)	2	2	2	2	2
	high intensity (>50% urbanized)	1	1	1	1	1
Wetland Land Use (Vwetuse)	low intensity	3	3	3	3	3
	moderate intensity	2	2	2	2	2
	high intensity	1	1	1	1	1
Wetland Water Regime (Vregm)	wet: permanently flooded, semi-permanently flooded	3	3	3	3	3
	drier: seasonally flooded, temporarily flooded, saturated	1	1	1	1	1

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Microrelief of Wetland	pronounced	3	3	3	3	3
Surface (Vmicro)	well developed	2	2	2	2	2
	poorly developed	1	1	1	1	1
	absent	0	0	0	0	0
Number of Wetland	5 or more types	3	3	3	3	3
Types (Vnum)	3-4 types	2	2	2	2	2
	1-2 types	1	1	1	1	1
	no vegetation	0	0	0	0	0
Relative Proportions of Wetland Types (Vprop)	even distribution	3	3	3	3	3
	moderately even distribution	2	2	2	2	2
	highly uneven distribution	1	1	1	1	1
	no vegetation	0	0	0	0	0
Vegetation Interspersion (Vintrspr)	high interspersion	3	3	3	3	3
	moderate interspersion	2	2	2	2	2
	low interspersion	1	1	1	1	1
	no vegetation	0	0	0	0	0
Number of Layers (Vlayers)	5 or more layers	3	3	3	3	3
	3-4 layers	2	2	2	2	2
	1-2 layers	1	1	1	1	1
	no vegetation	0	0	0	0	0
Percent Cover of Layers (Vlayers2)	layers well developed (>50% cover)	3	3	3	3	3
	layers with moderate cover (25-50%)	2	2	2	2	2
	layers poorly distinguishable (<25%)	1	1	1	1	1
	no vegetation	0	0	0	0	0

Variables (Variable Code)	Conditions	Weights (per HGM Class)				
		Riverine	Slope	Depressional	Flats	Lacustrine Fringe
Interspersion of Vegetation Cover and Open Water	26-75% scattered or peripheral	3	0	3	3	3
(Vopenwat)	>75% scattered or peripheral	2	0	2	2	2
	<25% scattered or peripheral	1	0	1	1	1
	100% cover or open water	1	0	1	1	1
	no vegetation	0	0	0	0	0
Size (Vsize)	large (>100 acres)	3	3	3	3	3
	medium (10-100 acres)	2	2	2	2	2
	small (<10 acres)	1	1	1	1	1
Wetland juxtaposition (Vjuxta)	other wetlands within 400 m and connected above or below	3	3	3	3	3
	other wetlands within 400 m but not connected	1	1	1	1	1
	wetland not connected	0	0	0	0	0
Model Range		**4-36**	**4-33**	**4-36**	**4-36**	**4-36**
Functional Capacity Index Range[a]		**0.11-1.0**	**0.12-1.0**	**0.11-1.0**	**0.11-1.0**	**0.11-1.0**

Note:

a. Scoring:

FCI = (Vsheduse + Vwetuse + Vregm + Vmicro + Vnum + Vprop + Vintrspr + Vlayers + Vlayers2 + Vopenwat + Vsize + Vjuxta) / 36 for depressional, lacustrine fringe, riverine, and flats wetlands.

FCI = (Vsheduse + Vwetuse + Vregm + Vmicro + Vnum + Vprop + Vintrspr + Vlayers + Vlayers2 + Vsize + Vjuxta) / 33 for slope wetlands.

Example of Contribution to Abundance and Diversity of Wetland Fauna

Figure B.8-1 shows a wetland on a floodplain landform that is connected upslope and downslope to other wetlands. The HGM class for this wetland is riverine. Table B.8-2 shows variable scores for the wetland shown in Figure B.8-1 (plot 3PP1093).

Figure B.8-1
Plot 3PP1093, Getmuna Creek Basin

Table B.8-2
Variables Scores for Wetland at Plot 3PP1093, Getmuna Creek Basin

Variables	Conditions	HGM Class - Riverine
Watershed Land Use (Vsheduse)	low intensity	3
Wetland Land Use (Vwetuse)	low intensity	3
Wetland Water Regime (Vregm)	drier: seasonally flooded, temporarily flooded, saturated	1
Micro-relief of Wetland Surface (Vmicro)	pronounced	3
Number of Wetland Types (Vnum)	1-2 types	1
Relative Proportions of Wetland Types (Vprop)	even distribution	3
Vegetation Interspersion (Vintrspr)	moderate interspersion	2
Number of Layers (Vlayers)	5 or more types	3
Percent Cover of Layers (Vlayers2)	layers with moderate cover (25-50%)	2

Variables	Conditions	HGM Class - Riverine
Interspersion of Vegetation Cover and Open Water (Vopenwat)	>75% scattered or peripheral	2
Size (Vsize)	small (<10 acres)	1
Wetland Juxtaposition (Vjuxta)	other wetland within 400 m and connected above or below	3
Total Variable Score		**27**
Functional Capacity Index[a]		**0.75**

Note:

a. FCI is calculated by dividing the total wetland variable score of 27 by the maximum possible score (3 per variable, or 36) for an FCI of 0.75: 27 / 36 = 0.75.

Appendix C

Descriptions of Variables Used in the Wetland Functional Models for the Donlin Gold Project

The following descriptions of variables in sections C.1 through C.4 follow the order they are presented in Section 2.2.2 with only a couple of exceptions. Each is noted with the number it is assigned in Table 2.2-2 to enable comparison.

C.1 Hydrologic Variables

1. Basin Topographic Gradient (Vtopo)

- *Definition*: The gradient of a wetlands basin is the change in elevation between the inlet and outlet divided by length.
- *Discussion*: The gradient of a basin is one factor that controls the storage of water within the basin. Basins with nearly flats gradients generally have larger and longer detention potential than basins with steep gradients. Nearly flats gradients (e.g., wetlands on lower perennial river floodplains) have a higher potential for sediments retention than those with steep gradients where erosion may occur.
- *Wetland functions that include this variable*:
  - Storm and floodwater storage,
  - Modification of stream flow,
  - Modification of water quality, and
  - Export of detritus.
- *Inventory method*: Generally, the gradient is measured with a hand-held inclinometer that directly reads gradient as percent slope. If a topographic map or on-screen GIS is used, the length of the wetland is measured from the highest end of the wetland to the lowest end. The change in elevation along this distance is also determined from the topographic information. The value is divided by the length and multiplied by 100 to provide a percent gradient.
- *Range of conditions*:
  - High gradient (greater than 2 percent), and
  - Low gradient (less than or equal to 2 percent).

2. Degree of Outlet Restriction (Vout)

- *Definition*: The degree of outlet restriction of a wetland basin is that point of its outlet that hydraulically controls the outflow.
- *Discussion*: The degree of outlet restriction controls the rate of discharge through the outlet and is a primary factor in determining flood storage in the wetland. Outlet controls range from free-flowing low-gradient channels (unrestricted outflow) to bedrock controlled outlet inverts and culverts (restricted outflow).
- *Wetland functions that include this variable*:
  - Storm and floodwater storage,
  - Modification of stream flow,
  - Modification of water quality, and
  - Export of detritus.

- *Inventory method*: The outlet of a wetland basin should be identified in the field, and it should be determined whether the outflow through the outlet is restricted or unrestricted. This method can be supplemented with the examination of aerial photographs.
- *Range of conditions*:
  - Restricted outflow,
  - Unrestricted outflow, and
  - No outflow.

3. Evidence of Sedimentation (Vsed)

- *Definition*: Direct observation of sediment on the surface of the wetlands soil or within the wetlands recent profile, which has occurred as a result of particulates settling from flood water.
- *Discussion*: The best indicator that sedimentation is occurring in wetlands is the direct observation of accumulations of sediment on or within soil, leaves, bark, and other surfaces that flood. This normally signifies that sediment is transported to the wetland from upslope or upstream. Some contaminants are normally attached to silt and clay particles, and the sedimentation incorporates these contaminants in the soil where they may be subject to further biogeochemical transformations.
- *Wetland functions that include this variable*:
  - Modification of water quality.
- *Inventory method*: Evidence of sedimentation is obtained by direct observation of the wetland soil, leaf litter, and other surfaces. The presence of sediment-created soils, such as fluvaquents, is observed in a soil pit dug at the site.
- *Range of conditions*:
  - Sediment observed on substrate,
  - Fluvaquent soils, and
  - No evidence observed.

4. Evidence of Seeps and Springs (Vsep-spr)

- *Definition:* Springs are distinct points on the land surface where groundwater discharges from the underlying geologic units as a point source and becomes surface water, soil water, or lacustrine water. Seeps are broad areas where groundwater discharges to the land surface.
- *Discussion:* Water enters wetlands in a number of ways. Direct precipitation enters all wetlands and for some wetlands (e.g., flats) may be the dominant water source. Other wetlands receive surface water inflow from streams and runoff from the surrounding watershed. Many wetlands are discharge areas for groundwater. The best indicator of groundwater discharge into a wetland (lacking nested piezometers) is the presence of seeps and springs, and soil saturation during periods lacking rainfall during the growing season.

- *Wetland functions that Include this variable:*
    - Modification of groundwater discharge,
    - Modification of groundwater recharge, and
    - Modification of stream flow.
- *Inventory method:* The wetland and its edge are visually inspected for the presence of springs or seeps. This can be supplemented with the examination of aerial photographs, especially for very large wetlands.
- *Range of conditions:*
    - No seeps or springs,
    - Seeps observed,
    - Perennial spring, and
    - Intermittent spring.

5. Frequency of Overbank Flooding (Vfreq)

- *Definition*: Overbank flooding is water that is generated by flood events that cannot be contained within the stream channel and flows over the banks and onto the floodplain. The frequency of overbank flooding is the return interval measured in years for a given flood stage (elevation).
- *Discussion*: Overbank flooding is the most significant water source for riverine wetlands. Turbid and high velocity water leaves the river channel and spreads onto the floodplain where it slows down and deposits much of its sediment load. This process creates natural levees and modifies the soil, vegetation, and wildlife habitat. The flooding can import nutrients, and the water returning to the channel contains detritus that is exported to downstream systems. The flood water that remains on the floodplain may be stored within the floodplain microrelief and soils, or evapotranspirates to the atmosphere. This modifies the downstream hydrograph of the stream, generally reducing peak discharge and flood stage.
- *Wetland functions that include this variable:*
    - Storm and floodwater storage, and
    - Modification of stream flow.
- *Inventory method*: In some parts of the United States, the frequency of overbank flooding may be interpreted from detailed Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs). These maps generally occur in two formats: detailed and general. Detailed FIRMs will include a flood profile that indicates the flood stages in elevation (feet) ranging from the 1-year to 100-year flood event.

  Where detailed FIRMs do not exist or cannot be adequately applied, then direct field observations or evidence of flooding must be obtained. Physical evidence of flooding can be observed in the field as silt-stained leaves, silt rings or ice marks on stems, debris lines, and other evidence. Familiarity with the tolerance of plant species to flooding regimes can also be helpful in determining the frequency of overbank flooding.
- *Range of conditions:*
    - Return interval of 1 to 2 years,
    - Return interval of greater than 2 to 5 years,

- Return interval of greater than 5 years, and
- No overbank flooding.

6. Inlet/Outlet Class (Vinout)

- *Definition*: This variable refers to the occurrence and relationships of surface water inlets and outlets of a wetland.
- *Discussion*: Inlets and outlets associated with wetlands have varying types of flow regimes and structural characteristics. An inlet may consist of a surface water channel cut into the land surface by fluvial processes, or be a man-made channel such as a lined ditch. Outlets can range from natural drainage channels to spillways on artificial structures such as dams. The relationship or lack of inlets and outlets can be indicators of a wetland's functions. For example, a wetland with a perennial outlet and no inlet indicates a groundwater discharge area. Wetlands having a perennial inlet and intermittent outlet may indicate groundwater recharge is occurring through the wetland. A wetland having no inlet or outlet performs long-term flood storage.
- *Wetland functions that include this variable*:
  - Modification of groundwater discharge,
  - Modification of groundwater recharge, and
  - Modification of stream flow.
- *Inventory method*: Inlets and outlets are observed and classified (i.e., perennial or intermittent) primarily during field inspections, although such observations may be supplemented by inspection of aerial photographs.
- *Range of conditions:*
  - No inlet/no outlet,
  - No inlet/intermittent outlet,
  - No inlet/perennial outlet,
  - Intermittent inlet/no outlet,
  - Intermittent inlet/intermittent outlet,
  - Intermittent inlet/perennial outlet,
  - Perennial inlet/no outlet,
  - Perennial inlet/intermittent outlet, and
  - Perennial inlet/perennial outlet.

7. Microrelief of Wetland Surface (Vmicro)

- *Definition*: Microrelief of the wetland surface is the degree of difference between the highest and lowest average elevations. Hummocks and tussocks are common features that exhibit distinct elevation differences between top of the feature and the lower space between features (depressions).
- *Discussion*: Microrelief of the wetland surface is one component of the roughness factor (Manning's equation). All other things being equal, the rougher the wetland surface the slower water will pass through. This will increase the detention time of the water in the

wetland. Variations in microrelief provide an additional element of habitat diversity. Plant species diversity is usually higher in a wetland having an irregular surface compared to one in which the surface is relatively flats.

- *Wetland functions that include this variable*:
  - Modification of groundwater discharge,
  - Modification of groundwater recharge,
  - Storm and floodwater storage,
  - Modification of stream flow, and
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method*: Microrelief of the wetland is determined by visual observation in the field, where the scientist assesses the occurrence and average height of hummocks, tussocks, and similar features.
- *Range of conditions:*
  - Pronounced (greater than 45 centimeters [cm]),
  - Well developed (15 to 45 cm), and
  - Poorly developed (less than 15 cm).

8. Nested Piezometer Data (Vnespiez)

- *Definition:* A piezometer is a small-diameter well designed to read water table elevations. Nested piezometers are two or more piezometers placed adjacent to each other, with screens set at substantially different depths in the water table.
- *Discussion:* Data obtained from groundwater table-level reading from nested piezometers allow detection of the direction of flow in a water-bearing geological unit. Three hydraulic extremes in flow directions are possible: upward movement (discharge), downward movement (recharge), and horizontal or lateral flow. The data are most useful for determining the recharge or discharge conditions of a wetland.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge, and
  - Modification of stream flow.
- *Inventory method:* Nested piezometers are installed and monitored to measure or approximate aquifer hydraulic flow direction.
- *Range of conditions:*
  - Recharge,
  - Discharge,
  - Horizontal flow, and
  - Not available.

9. pH (VpH)

- *Definition:* This variable is defined as a measure of the concentration of the hydrogen ion in the water in the wetland (degree of its acid or alkaline reaction).
- *Discussion:* pH within the wetland can have an impact on the characteristics of the faunal and plant communities. It can also be of value in predicting whether the wetland is a groundwater discharge point or if its water budget is dominated by precipitation and runoff. This information is important, for example, in predicting the wetland modification of water flow from the groundwater system to the surface water system (stream flow). Data obtained from groundwater table-level readings from nested piezometers enable detection of the direction of flow in a water-bearing geological unit. Three hydraulic extremes in flow directions are possible: upward movement (discharge), downward movement (recharge), and horizontal or lateral flow. The data are most useful for determining the recharge or discharge conditions of a wetland.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge, and
  - Modification of stream flow.
- *Inventory method:* A pH meter is used to determine the pH of the wetland surface water. Preferably, the reading should be taken in a naturally occurring pool of water. However, if no water can be located, the reading can be taken in a soil pit.
- *Range of conditions:*
  - Acid (less than 5.5),
  - Circumneutral (5.5 to 7.4),
  - Alkaline (greater than 7.4), and
  - No water.

10. Ratio of Wetland Area to Watershed Area (Varea)

- *Definition:* This variable is determined by dividing the wetland area by the watershed area, which yields a percentage when multiplied by 100.
- *Discussion:* The size or area of the watershed is one factor that controls the wetland's water budget; the larger the surface area of the watershed that flows to a wetland, the more water will flow to the wetland. This, as well as other factors, also controls the amount of sediment and particulates that enter the wetland, the wetland's water regime, and its flood storage and recharge potential.
- *Wetland functions that include this variable:*
  - Storm and flood water storage and
  - Modification of stream flow.
- *Inventory method:* The watershed area and the wetland area are most conveniently measured on digital topographic maps or aerial photography in a GIS. The watershed is delineated by locating the divides between the watershed and the surrounding watersheds.

- *Range of conditions:*
  - High (equal to or greater than 10 percent) and
  - Low (less than 10 percent).

<u>11. Relationship of Wetland's Substrate Elevation to Regional Piezometric Surface (Vregpiez)</u>

- *Definition:* The piezometric surface is the level to which groundwater will rise in a piezometer. The relationship of a wetland's substrate to the regional piezometric surface is the elevation of the substrate relative to the elevation of the piezometric surface.
- *Discussion:* Some areas have had detailed regional groundwater investigations conducted by the USGS or other scientists. In these studies, the elevation of the regional piezometric surface is shown on maps as contours. Occasionally, the piezometric surface may have been determined for a specific site. Knowing the elevation of the piezometric surface at the wetland and the elevation of the wetland's substrate enable comparison of the two elevations. These types of data, however, are usually not available for most project areas.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge, and
  - Modification of stream flow.
- *Inventory method:* In limited areas, data may be available from the USGS or individual state geological surveys. Rarely, a project may include a program that includes regional groundwater investigations that allow for the piezometric surface to be determined. In some areas, the piezometric surface can be determined using water-table elevations obtained from water-table monitoring wells and from known discharge points, such as perennial springs, streams, rivers, and lakes known to be discharge areas.
- *Range of Conditions:*
  - Maximum piezometric surface above or at wetland substrate elevation,
  - Minimum piezometric surface below wetland substrate elevation, and
  - Not available.

<u>12. Surface Water Level Fluctuation (Vsurwat)</u>

- *Definition:* Water level fluctuation is the measure of the yearly rise and fall of surface water above the wetland substrate.
- *Discussion:* Water level fluctuations occur for many reasons including groundwater recharge and discharge, stream or lake overbank flooding, accumulation of runoff and precipitation, and evapotranspiration. Some wetlands are never inundated, or are inundated so infrequently and to such a shallow depth that no evidence of water level fluctuation can be observed during dry periods.

  Water level fluctuation influences most wetland functions. It may be an indicator of long-term and short-term surface water storage, and groundwater discharge. Water level fluctuations have a direct impact on wetland plant and animal communities. They bring nutrients into the wetland and may result in export of detritus.

- *Wetland functions that include this variable:*
  - Modification of groundwater recharge,
  - Storm and flood water storage, and
  - Modification of stream flow.
- *Inventory method:* The degree of water level fluctuation can be directly measured in the field by various types of water level gauges. However, this type of information is usually not available. Indirect physical evidence of flooding is normally used. Indirect physical evidence includes silt-stained leaves, silt rings on stems, debris lines, and other evidence. Knowledge of the tolerance for flooding or inundation by plant species or plant communities can be a reliable way to estimate water level fluctuation. This type of correlative observation usually requires a minimum of several field seasons of work in a particular region.
- *Range of conditions:*
  - High fluctuation,
  - Low fluctuation, and
  - Never inundated.

<u>13. Surficial Geologic Deposit Under the Wetland (Vsurgeo)</u>

- *Definition:* This variable describes the dominant type of surficial geologic deposit which occurs under the wetland's soil.
- *Discussion:* The type of surficial geologic deposit under the wetland influences the wetland's groundwater recharge and discharge functions. Glacial till has low permeability and is not a high transmissivity aquifer; till therefore, is not likely to be a significant area for groundwater discharge. Glacio-fluvial deposits have high permeability and are generally high transmissivity aquifers. Wetlands associated with these deposits are generally discharge areas.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge, and
  - Modification of stream flow.
- *Inventory method:* Borings are the only absolute data for this variable, but the underlying surficial geologic deposit can be predicted by the surrounding surficial geologic deposit. For some areas, these are illustrated on USGS surficial geologic maps or can be inferred from NRCS soil series maps.
- *Range of conditions:*
  - Low permeability stratified deposits (glacio-lacustrine),
  - High permeability stratified deposits (glacio-fluvial, alluvial, colluvial), and
  - Glacial till.

14. Wetland Land Use (Vwetuse)

- *Definition:* Land use of a wetland consists of those human activities that occur within the boundaries of the wetland and alter the wetland's vegetation, hydrology, chemistry, or soil. Examples include cutting of woody vegetation, agricultural uses, and ditching.
- *Discussion:* Land use of a wetland can directly impact wetland functions. For example, forestry or clearing for agricultural purposes drastically changes the vegetation community, diminishing its value for many of the functions.
- *Wetland functions that include this variable:*
  - Modification of water quality,
  - Export of detritus, and
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* Direct observation of the land use conditions of the wetland is the primary inventory method. This method can be supplemented with interpretation of recent aerial photography, especially for large wetlands.
- *Range of Conditions:*
  - High intensity land use such as agricultural (e.g., row crops).
  - Moderate intensity land use such as grazing and forestry.
  - Low intensity land use. This category includes those land uses, such as open space and recreation that have little or no impact on the wetland's vegetation, soils, and hydrology.

15. Wetland Water Regime (Vregm)

- *Definition:* This variable refers to the duration and timing of surface water inundation and/or saturation caused by surface water, precipitation, and groundwater inflow.
- *Discussion:* The wetland's water regime has an influence on all wetland functions. For example, seasonally flooded and temporarily flooded (drier) water regimes are more likely to export detritus than a permanently flooded (wet) regime.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge,
  - Storm and flood water storage,
  - Modification of stream flow,
  - Export of detritus, and
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* The dominant water regime modifiers per Cowardin et al. (1979) are used to classify hydrologic regime. The information is usually obtained by direct observation, although National Wetlands Inventory maps can also be consulted. Knowledge of the tolerance for flooding or inundation by plant species or plant communities can be a reliable way to estimate the water regime in a wetland.

- *Range of conditions:*
  - Wet regimes: permanently flooded, intermittently exposed, and semi-permanently flooded, and
  - Drier regimes: Seasonally flooded, temporarily flooded, intermittently flooded, and saturated.

C.2 Vegetation Variables

<u>16. Cover Distribution (Vcover)</u>

- *Definition:* The manner in which the vegetation in each layer is distributed in the wetland, whether growing singly, in small clumps, or in dense stands.
- *Discussion:* A given layer of vegetation may have very different distribution characteristics than a comparable layer in another wetland having a similar percent cover. This difference may be due to the growth characteristics of the dominant species, distribution mechanisms, or environmental gradients. This variable provides information on the surface roughness of the wetland and structural characteristics that affect functions such as modification of water quality.
- *Wetland functions that include this variable:*
  - Modification of water quality.
- *Inventory method:* Cover distribution of the dominant layer can often be determined from aerial photography; however, a site visit is the preferred method for determining cover distribution.
- *Range of conditions:*
  - Forming a continuous cover,
  - Growing in small scattered patches,
  - Growing in one or more large patches with portions of the site open, and
  - Growing as solitary, scattered stems.

<u>17. Dead Woody Material (Vwood)</u>

- *Definition:* Standing and fallen trunks, stems, and branches of woody plants.
- *Discussion:* Due to senescence of woody plant parts, dead standing trees, and shrubs, logs and woody debris generally become a component of wetland vegetation community structure. This variable is relevant primarily for the contribution to the storm and flood water storage and faunal abundance and diversity functions.
- *Wetland functions that include this variable:*
  - Storm and flood water storage,
  - Modification of stream flow, and
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* Dead woody material is visually estimated during a site visit.
- *Range of conditions:*
  - Abundant (greater than 50 percent of wetland surface),

- Moderate abundance (25 to 50 percent of wetland surface), and
- Low abundance (0 to 25 percent of wetland surface).

<u>18. Dominant Wetland Type (Vtype)</u>

- *Definition:* Dominant wetland type is defined as that type that occupies the greatest area of the wetland. A wetland type consists of the wetland class, subclass, and dominance type as defined by Cowardin et al. (1979).
- *Discussion:* Wetland types seldom consist of a single life form, but commonly contain multiple life forms (e.g., shrubs and emergents) and species. The dominant type occupies the greatest area of a wetland. Dominant wetland type affects structure and composition characteristics of the wetland that may influence certain functions.
- *Wetland functions that include this variable:*
  - Modification of water quality.
- *Inventory method:* Dominant wetland type may be determined from aerial photographs, but a site visit is usually necessary to confirm observations.
- *Range of conditions:*
  - Forested wetland, evergreen, needle-leaved,
  - Forested wetland, deciduous, broad-leaved,
  - Forested wetland, deciduous, needle-leaved,
  - Scrub-shrub, evergreen, broad-leaved,
  - Scrub-shrub, evergreen, needle-leaved,
  - Scrub-shrub, deciduous, broad-leaved,
  - Scrub-shrub, deciduous, needle-leaved,
  - Emergent wetland, persistent,
  - Emergent wetland, non-persistent, and
  - Aquatic bed.

<u>19. Interspersion of Vegetation Cover and Open Water (Vopenwat)</u>

- *Definition:* The relative proportions and distribution of vegetation and open water in a wetland.
- *Discussion:* Interspersion of cover and open water generally varies with the developmental stage of the wetland community. In forested wetlands, for example, the vegetated portion may occupy all of the wetland, whereas in emergent wetlands and aquatic beds the proportions of open water may be higher. Vegetation may occur in a peripheral band in the wetland or in scattered patches. This variable is relevant primarily for the contribution to the faunal abundance and diversity function but also plays a role in several other functions.
- *Wetland functions that include this variable:*
  - Contribution to abundance and diversity of wetland fauna.

- *Inventory method:* This variable is generally best observed on large-scale aerial photographs, especially for larger wetland areas. Field reconnaissance may also be necessary to accurately estimate the relative proportion of open water and vegetation and the distribution of these cover types.
- *Range of conditions:*
  - 26 to 75 percent scattered cover,
  - 26 to 75 percent peripheral cover,
  - Greater than 75 percent scattered cover,
  - Greater than 75 percent peripheral cover,
  - Less than or equal to 25 percent scattered cover,
  - Less than or equal to 25 percent peripheral cover,
  - 100 percent cover, and
  - 100 percent open water.

<u>20. Number of Layers (Vlayers) and 22. Percent Cover (Vlayers2)</u>

- *Definition:* The number of distinct vertically distributed vegetation life form layers (e.g., herbaceous, low shrub, and tall shrub) and percent cover of each layer in a wetland. Due to the ecological linkage of these variables (number of layers and percent cover of layers), they are defined and described together.
- *Discussion:* Starting at the ground surface there can be a number of distinct layers, each composed of a distinct life form, such as herbaceous, low shrub, tall shrub, sapling, and tree. This condition is known as foliage height diversity, which is a measure of stratification in the vertical distribution of vegetation. Foliage-height diversity increases with the number of layers and the density of branches and leaves in each layer. The highest diversity is attained in highly stratified communities with dense growth of foliage from the ground to the canopy. The two variables provide an important means of characterizing wetland community structure, which can affect several of the functions.
- *Wetland functions that include the two variables:*
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* These two variables are best inventoried by means of direct field observations at the wetland. The layers corresponding to vegetation life forms are defined based on whether sufficient coverage is present for a given life form to be clearly discernible as a distinct layer (at least 10 percent cover). An estimate of percent cover expressed for the entire wetland is then made for each distinct layer. The different life form layers to be assessed are as follows:
  - Layer 1: Submergents,
  - Layer 2: Floating,
  - Layer 3: Mosses and lichens,
  - Layer 4: Short herbs (less than 1 m),
  - Layer 5: Tall herbs (equal to or greater than 1 m),
  - Layer 6: Dwarf shrubs (less than 0.5 m),

- Layer 7: Short shrubs (0.5 to 2 m),
- Layer 8: Tall shrubs (greater than 2 to 6 m),
- Layer 9: Saplings (less than 5-inch–diameter-at-breast height [dbh] and less than 6 m tall), and
- Layer 10: Trees (equal to or greater than 5-inch dbh and equal to or greater than 6 m tall).

- *Range of conditions:*
  - Number of layers:
    - 6 or more
    - 5
    - 4
    - 3
    - 2
    - 1
  - Percent cover of layers:
    - Layers well developed (50 percent cover),
    - Layers with moderate cover (25 to less than or equal to 50 percent),
    - Layers poorly distinguishable (less than 25 percent), and
    - Vegetation absent.

<u>21. Number of Wetland Types (Vnum) and 24. Relative Proportions of Wetland Types (Vprop)</u>

- *Definition:* These wetland inventory variables are defined by the number of different wetland types occurring within the wetland boundary and the percent of the wetland area occupied by each type. Due to the ecological linkage of these two variables, they are defined and described together.
- *Discussion:* A wetland may contain more than one wetland type, each having a distinct life form and/or species composition. In general, as the number of wetland types increases so do the structural and plant species diversity of the wetland. The relative evenness in percent area occupied by each type can play an important role in the overall structural diversity of the wetland, the optimal condition depending on which function is being assessed.
- *Wetland functions that include the two variables:*
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* The number of wetland types in a wetland can be determined from field observations or by interpreting large-scale aerial photographs. The number of types (e.g., forested wetland and emergent wetland) is totaled, and the percent of the wetland occupied by each type is estimated or measured. The various wetland types are identified on the basis of the dominant life forms and species.
- *Range of conditions:*
  - Number of wetland (vegetation) types:
    - Greater than 5
    - 5

- 4
- 3
- 2
- 1

- Evenness of distribution:
    - Even distribution (one type; two types equal 45 to 55 percent; three types equal 30 to 35 percent),
    - Moderately even distribution (30 to 44 percent, 56 to 70 percent), and
    - Highly uneven distribution (0 to 29 percent, 71 to 100 percent).

23. Plant Species Diversity (Vdivers)

- *Definition:* Plant species diversity is defined as the number of plant species per unit area.
- *Discussion:* This variable is a direct indicator of the capacity of the wetland to produce a variety of plant species and contribution to biodiversity, serve as a genetic repository, and support wildlife. As the number of different plant species in a wetland increases, the species diversity of invertebrate and vertebrate animal species often increases also.
- *Wetland functions that include this variable:*
    - Contribution to abundance and diversity of wetland vegetation.
- *Inventory method:* Plant species diversity is assessed by inventorying plant species within standardized plots (e.g., 0.1-acre plots). The plots should be representative of the wetland plant community being assessed.
- *Range of conditions:*
    - Low diversity (0 to 9 vascular species),
    - Medium diversity (10 to 18 vascular species), and
    - High diversity (greater than 18 vascular species).

25. Vegetation Density/Dominance (Vvegden)

- *Definition:* Vegetation density is defined as the number of plants per unit area; dominance is expressed as percent cover or basal area.
- *Discussion:* Vegetation density/dominance can serve as an index of primary production in the early stages of wetland plant community development, such as in the emergent and scrub-shrub stages. In a mature stage, such as a forested wetland, a large amount of biomass may be present but primary production may be moderate. As an index of biomass and sometimes also of primary production, and as an expression of plant community structure, vegetation density can serve as a useful capacity indicator for several functions.
- *Wetland functions that include this variable:*
    - Storm and flood water storage,
    - Modification of stream flow,
    - Export of detritus, and
    - Contribution to abundance and diversity of wetland vegetation.

- *Inventory method:* Density is measured using visual estimates at the wetland site according to the abundance classes listed in the range of conditions. The percent of the wetland's surface not covered with vegetation (e.g., bare ground and water) is subtracted from 100 percent to obtain the vegetation density measurement.
- *Range of conditions:*
  - Sparse (0 to 19 percent),
  - Low density (20 to 39 percent),
  - Medium density (40 to 59 percent),
  - High density (60 to 79 percent), and
  - Very high density (80 to 100 percent).

<u>26. Vegetation Interspersion (Vintrspr)</u>

- *Definition:* Vegetation interspersion is defined on the basis of the number of different kinds of edge (line of contact between two or more vegetation types) and the length of each kind.
- *Discussion:* Interspersion increases as the tendency toward dominance by one or two vegetation types increases, the variety of groups increases, the boundaries become more irregular, and the percent area occupied by the groups becomes more even. Overall, vegetation interspersion increases as both the number of kinds of edge and total length of edge increase. These factors are closely correlated with habitat quality and carrying capacity for wildlife.
- *Wetland functions that include this variable:*
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* Interspersion of the wetland classes and subclasses of Cowardin et al. (1979) can be assessed by visual observation during site visits or by interpreting large-scale aerial photographs.
- *Range of conditions:*
  - High interspersion – groupings of vegetation are small, diverse, and interspersed; and length and types of edge are high.
  - Moderate interspersion – vegetation types occur in broken, irregular rings and evenness in percent area covered; and length and types of edge are moderate. Low density (20 to 39 percent).
  - Low interspersion – vegetation types occur in large, homogenous patches or in concentric rings; and length and types of edge are low.

C.3 Soil Variables

<u>27. Soil Type (Vsoil)</u>

- *Definition:* Soil type is defined by the dominant soil series or mapping unit occurring within the wetland, as determined by the NRCS or by examining the soil in a pit dug at the site. The soil is identified as either a histosol (organic hydric soil) or one of the various mineral hydric soils.

- *Discussion:* Soil is an important variable in a wetland. The high organic content of histosols influences removal and detention of dissolved elements and biogeochemical transformations. Histosols may provide long-term water storage. The coarser-grained mineral hydric soils may have high permeabilities that allow groundwater recharge, while histosols generally have low permeabilities that reduce groundwater recharge.
- *Wetland functions that include this variable:*
  - Modification of groundwater discharge,
  - Modification of groundwater recharge,
  - Modification of stream flow,
  - Modification of water quality, and
  - Export of detritus.
- *Inventory method:* Soil type is usually determined by examining the soil in a pit dug at the wetland. The soil types identified in the range of conditions are defined using NRCS soil description standards.
- *Range of conditions:*
  - Histosol:
    - Fibric,
    - Hemic, and
    - Sapric.
  - Mineral hydric soil:
    - Gravelly,
    - Sandy,
    - Silty, and
    - Clayey.

C.4 Landscape Variables

<u>28. Size (Vsize)</u>

- *Definition:* Size is the area of the wetland.
- *Discussion:* The size of the wetland usually has a direct bearing on its level of performance for most of the defined functions. In many cases the larger the wetland, the greater will be the function per unit area of the wetland. Also, all other factors being equal, a larger wetland will have more total capacity for a given function than a smaller one.
- *Wetland functions that include this variable:*
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* The size of the wetland is measured on digital maps or aerial photographs in a GIS environment, or visually estimated in the field if it clearly falls into one of the range categories listed below.
- *Range of conditions:*
  - Small (less than 10 acres),

- Medium (10 to 100 acres), and
- Large (greater than 100 acres).

29. Watershed Land Use (Vsheduse)

- *Definition:* Watershed land use refers to those human activities that modify the vegetation cover and hydrologic patterns of the land surface. They range from the most intense, such as industrial, to the least intense, such as open space. Moderate intensity land use activities include rural residential, agricultural, and forestry.
- *Discussion:* Land use within the watershed to a large degree governs the amount, rate, and chemical nature of runoff reaching the wetland. Urbanized areas with industrial, commercial, and dense residential areas have high rates of runoff. These high intensity land uses also add pollutants to the runoff.

  The life-cycle requirements of many faunal species are satisfied partly in wetlands and partly in the adjacent uplands. Undisturbed areas surrounding a wetland also provide a buffer against human disturbance. Wetlands bordered by agriculture, forest land, and open land provide better habitat for wildlife than those surrounded by industrial, housing, or outdoor recreational facilities. This variable plays an important role in contributing to an abundance and diversity of wetland fauna.
- *Wetland functions that include this variable:*
  - Contribution to abundance and diversity of wetland fauna.
- *Inventory method:* The nature of watershed land use may be determined by interpreting aerial photographs and by observing conditions during a field reconnaissance.
- *Range of conditions:*
  - High intensity land use – includes industrial, commercial, and urban residential (more than 50 percent urbanized);
  - Moderate intensity land use – includes suburban residential, agricultural, and forestry (25 to 50 percent urbanized), and
  - Low intensity land use – includes undeveloped open space (0 to 25 percent urbanized).

30. Wetland Juxtaposition (Vjuxta)

- *Definition:* Wetland juxtaposition refers to the location of a wetland relative to other wetlands.
- *Discussion:* Wetlands may be completely isolated, occur near other wetlands but are not connected, or may be hydrologically connected. The proximity of a wetland to other wetlands may be an important factor in evaluating its contribution to plant diversity, particularly if species diversity within the wetland is low. The level of function of a wetland relative to maintenance of faunal communities is higher if it is located near other wetlands, particularly if the wetlands are connected by surface water.
- *Wetland functions that include this variable:*
  - Contribution to abundance and diversity of wetland vegetation and
  - Contribution to abundance and diversity of wetland fauna.

- *Inventory method:* Proximity to other wetlands and surface connections can be determined from aerial photography supplemented with field reconnaissance of the wetland perimeter.
- *Range of conditions:*
  - Connected upstream and downstream,
  - Only connected above,
  - Only connected below,
  - Other wetlands nearby but not connected (400 m or closer), and
  - Wetland not connected.

Appendix D

Offsite Characterization of Functional Assessment Variables
Draft Guidelines

Offsite Characterization of Functional Assessment Variables

Draft Guidelines

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Version 01

Limitations

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Table of Contents

Donlin Introduction

This guidebook has been developed to assist environmental professionals employed by or subcontracted through Three Parameters Plus, Inc. (3PPI) to assign attributes to functional assessment variables offsite. The guidelines were developed for application in areas in which extensive field sampling has been conducted, including characterization and functional assessment of comparable, nearby wetlands.

3PPI has conducted extensive field work in the Donlin Creek project area, including over 1500 Jurisdictional Wetland Determinations and over 850 onsite functional assessments. These data have been compiled into a georeferenced project database, the Smart Client Application (SCA), and are available to project environmental professionals completing offsite functional assessment.

Many of the fields throughout the SCA database plot assessment form will have been autopopulated prior to the Offsite Functional Assessment and will be uneditable. Unless otherwise noted, *these fields should be reviewed during the Offsite Functional Assessment.* If the autopopulated entry is inappropriate, outline your reasoning in the notes section of the applicable tab. In addition, compile a list of the discrepancies you have noted (reference the Polygon ID number on the Location Tab, the tab containing the questionable data, and include a brief description of your objection). When you have completed all assigned Offsite Functional Assessments, forward this list to the Project Manager. The Project Manager will review this information and available supporting data to determine whether these entries need to be adjusted.

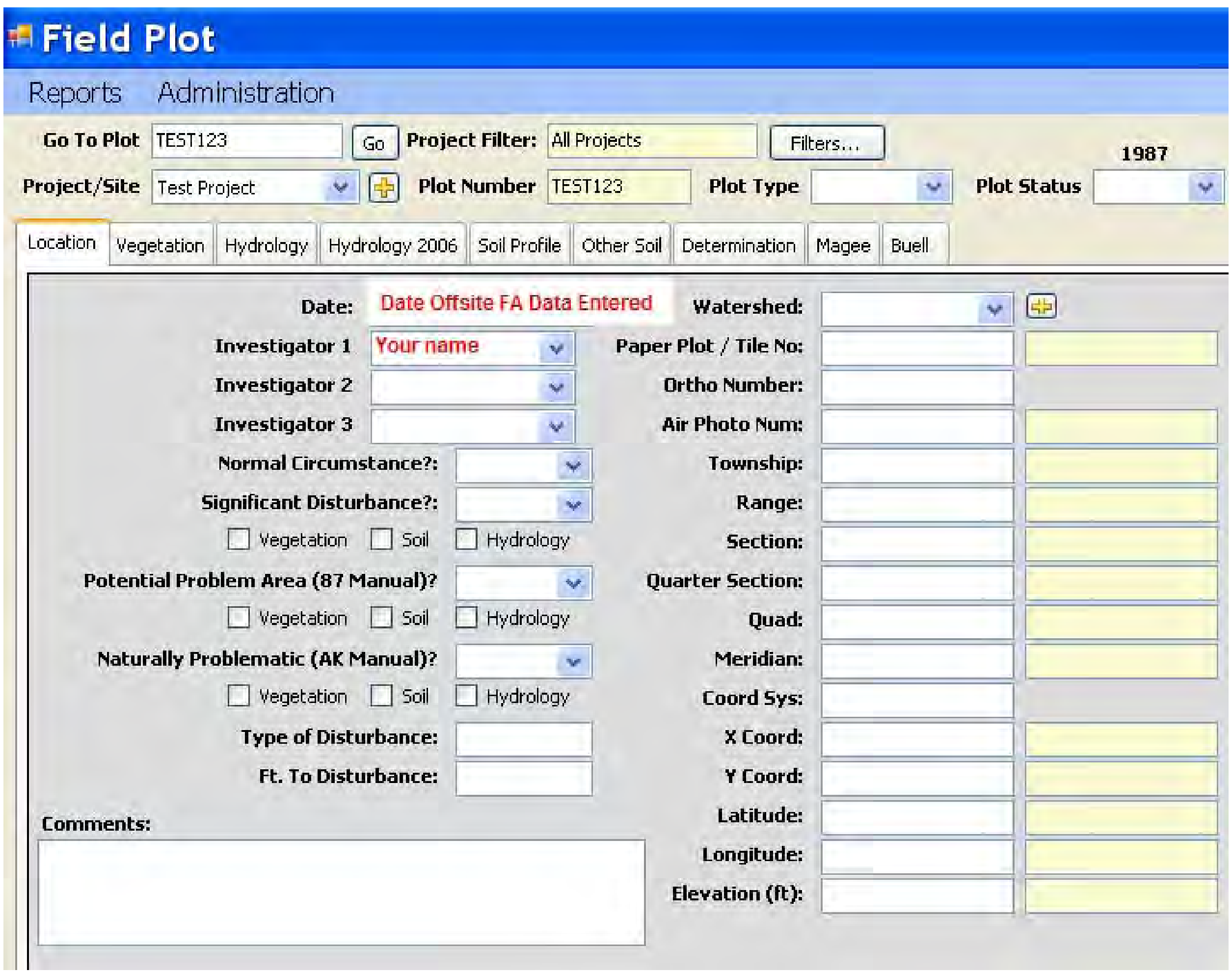
Several of the functional assessment variables (e.g., wetland size, plant diversity) may be objectively assessed offsite through analyses of geodatabase resources and/or field data collected in nearby, comparable wetlands. Other functional assessment variables require a combination of field data review and best professional judgment. For these variables, it is essential that the environmental professional assigning the variable attributes have access to the project environmental geodatabase and to the field data set. These resources should be used to gather supporting data collected within the project. If available, collateral data sets may also assist in the assessment of some variables. These other data sets include surficial geology maps, soil surveys, piezometer records, and stream gauge data.

The functional assessment variables in this guide are described in more detail in Magee and Hollands (1998). The protocol for assessment of these variables in the field is provided as Appendix A to this document. The illustrations of drop-down menus provided for each Functional Assessment variable in this guidebook are reproductions of the applicable portions of the 3PPI SCA database.

SCA Location Tab

The relevant location information will be autopopulated by the database (an autopopulated example was unavailable during development of this guidebook). In the spaces indicated below, enter your name and the date the offsite functional assessment data were entered in the database.

In addition to the fields below, the Location Tab will include an RDI polygon number. The “search for “ ArcGIS function and the RDI polygon number may be used to locate the target wetland polygon in the geodatabase.



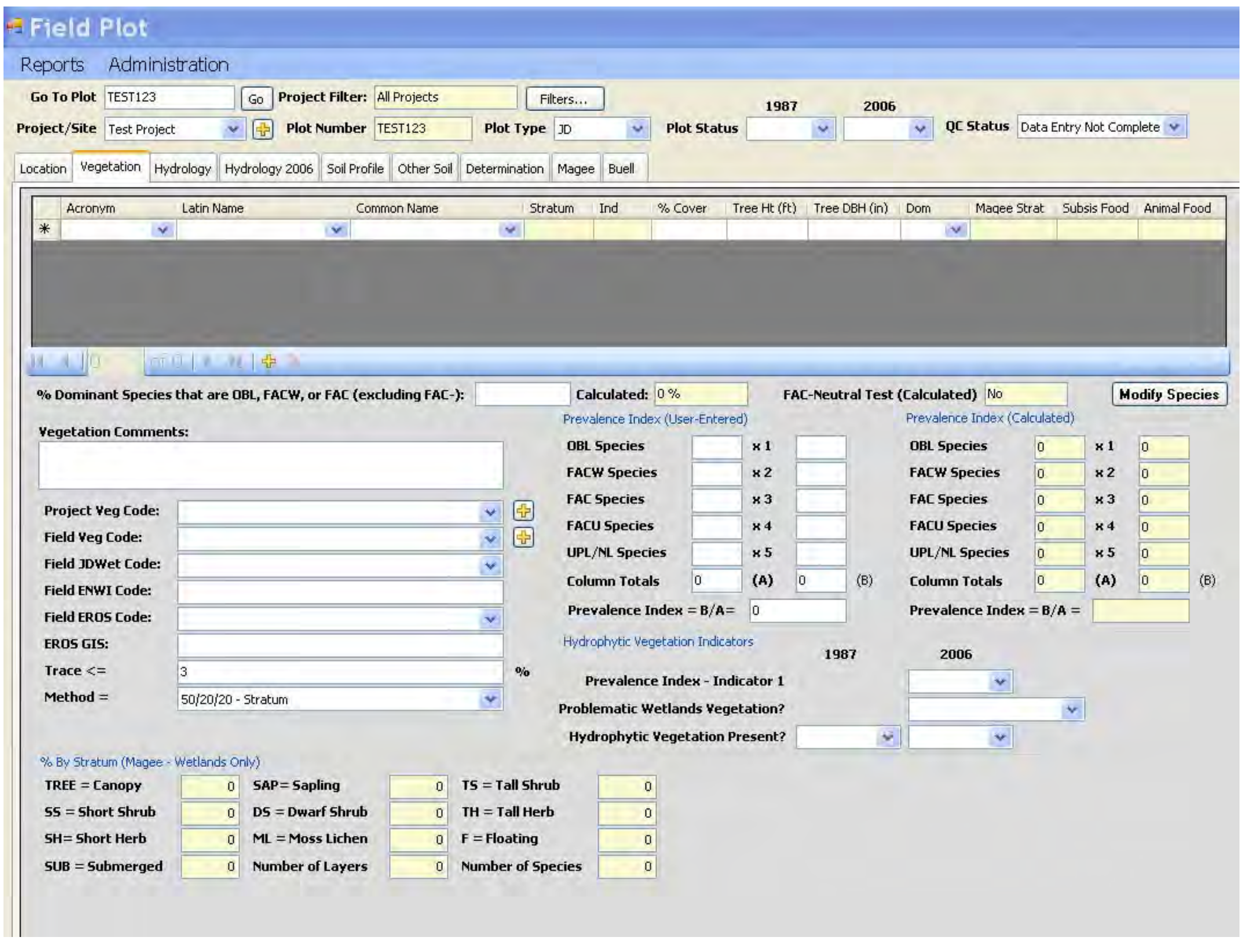
SCA Vegetation Tab

The vegetation table will contain several autopopulated, uneditable fields, including a list of plant species and % cover values. The vegetation list was derived from data collected during field visits to the watershed containing the target polygon. To generate the list, the database used species information collected in plots with the same HGM class and Vegetation Type as the target polygon. The information in the JDWet and ENWI fields was attributed to this polygon during the coding process.

If your review indicates the autopopulated fields have been completed appropriately, add the following comment to the Vegetation Comments field:

The plant species list and cover values, JDWet, and ENWI codes, were determined to be consistent with the available photoimagery by (your initials) on (date)

If your review indicates one or more of the autopopulated fields contains inappropriate data, note your reasoning in the comments field and notify the Project Manager (see Introduction).

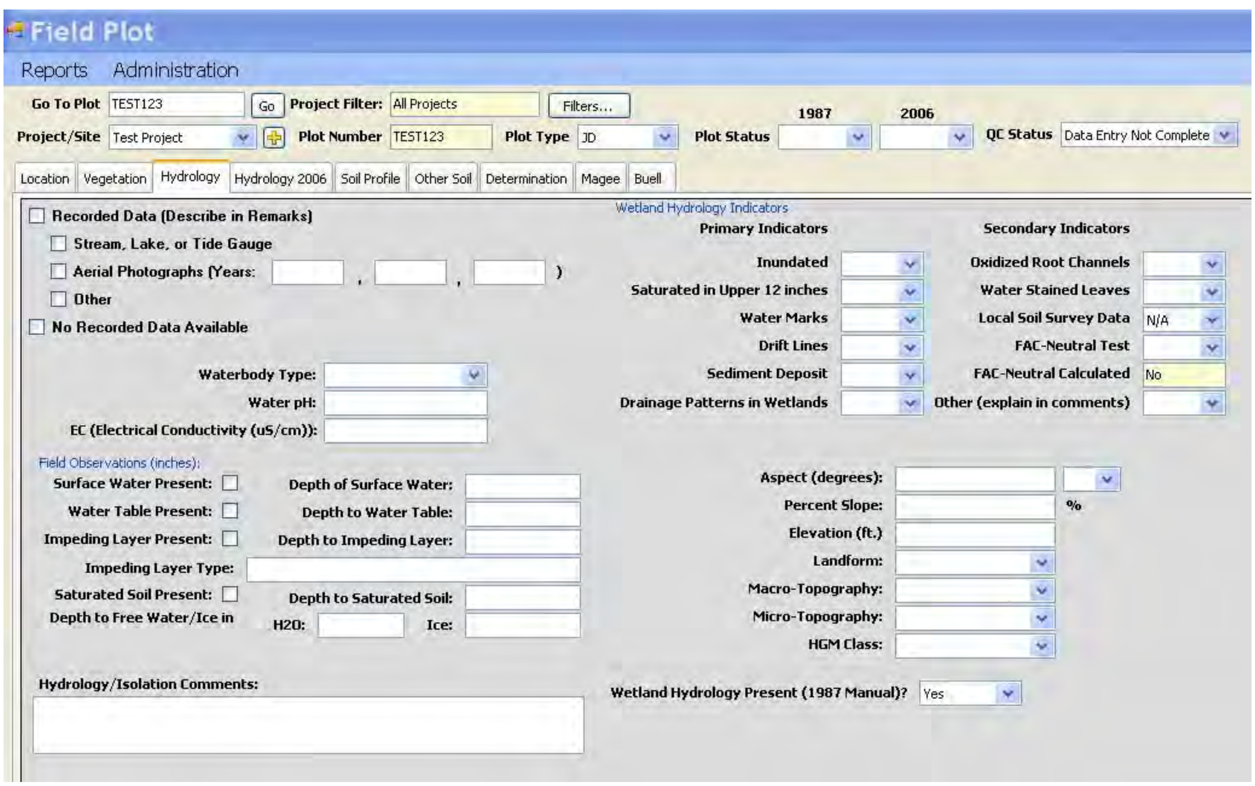


SCA Hydrology Tab

Review the autopopulated HGM Class designation. If this designation has been made correctly, insert the following comment in the “Hydrology/Isolation Comments” field, below:

The assigned HGM class was reviewed by (your initial) on (date)

If your review indicates the autopopulated field contains inappropriate data, note your reasoning in the comments field and notify the Project Manager (see Introduction).

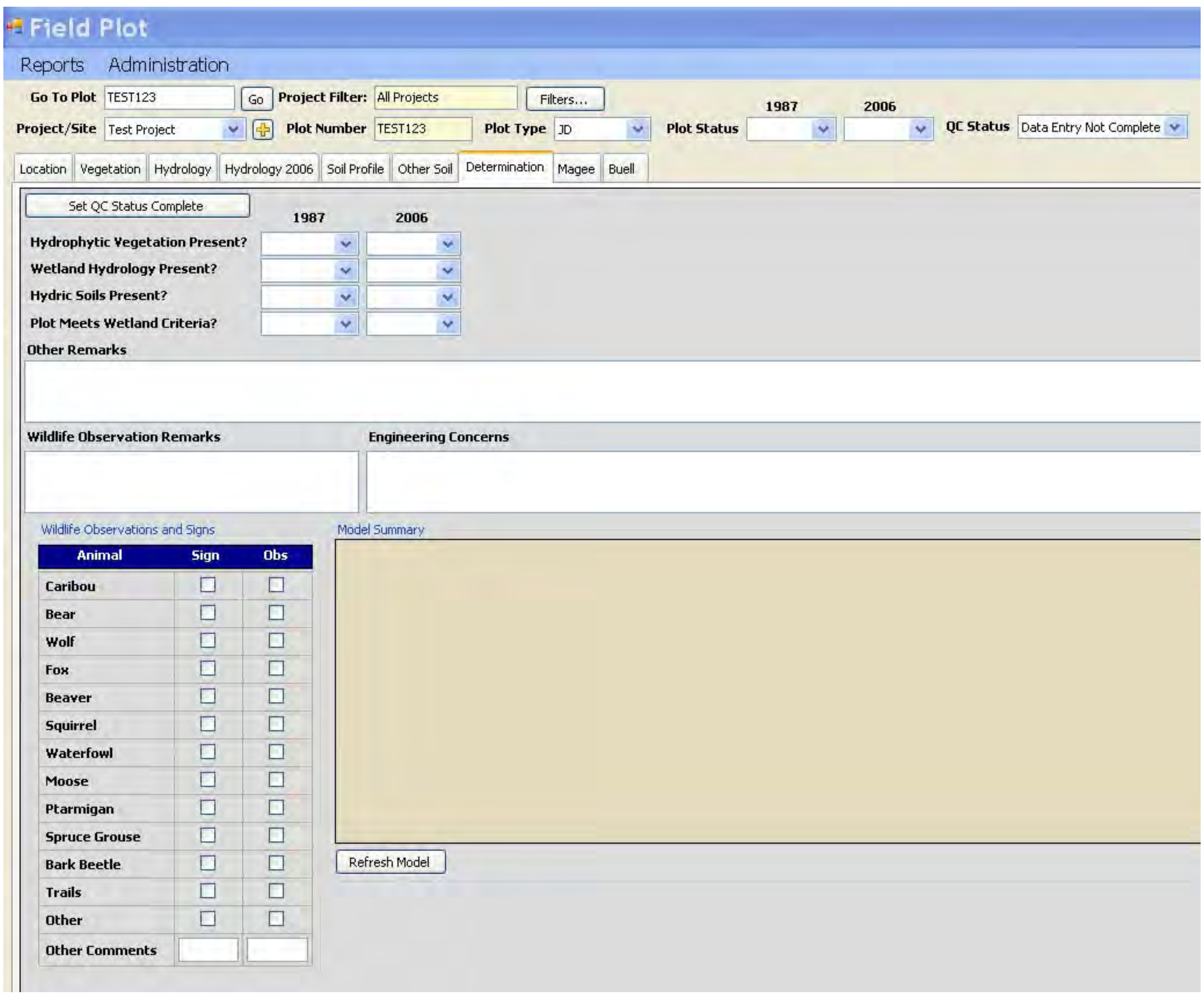


SCA Determination Tab

Add the comment "Functional Assessment completed offsite by (your initials) on (date)" to the "Other Remarks" field.

If problems were encountered during the Offsite Functional Assessment, these should be described in the "Other Remarks" field (see Introduction).

In some projects, there may be a Senior Review of the Offsite Functional Assessment information entered by the Primary Investigator. The person completing the Senior Review should add the comment "Senior review of Offsite Functional Assessment completed by (initials, date)."



SCA Functional Assessment Tab

Land Management Variables

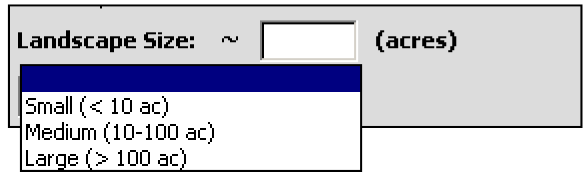
1. Miscellaneous Factors

This variable is not included within the numerical functional assessment model (Magee and Hollands 1998). However, the variable options may be used to tag wetland polygons in the database that are included within special management units or are regionally scarce.

Offsite Determination:
The available Land Management options will vary among projects. Refer to project GIS layers to assign the correct land management option. This variable may be autopopulated by the database for some projects.

Landscape Variables

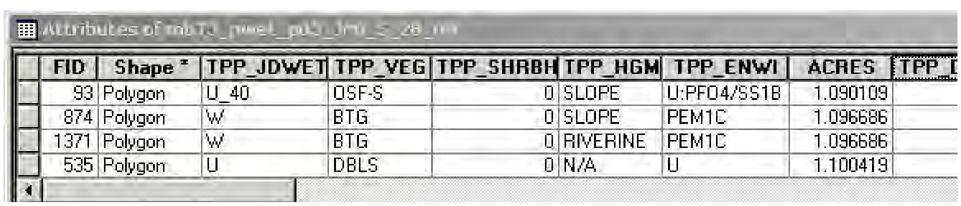
1. Size



This variable supports the following function (Magee and Hollands 1998):

Contribution to Abundance and Diversity of Wetland Fauna

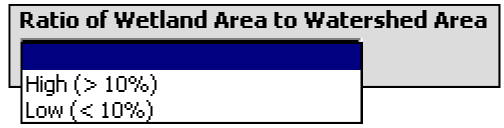
Offsite Determination:
The wetland acreage is displayed in the attribute table associated with the polygon shapefile (Figure 1).



FID	Shape *	TPP_JDWET	TPP_VEG	TPP_SHRBH	TPP_HGM	TPP_ENWI	ACRES
93	Polygon	U_40	OSF-S	0	SLOPE	U:PFO4/SS1B	1.090109
874	Polygon	W	BTG	0	SLOPE	PEM1C	1.096686
1371	Polygon	W	BTG	0	RIVERINE	PEM1C	1.096686
535	Polygon	U	DBLS	0	N/A	U	1.100419

Figure 1. The geodatabase attribute table may be set to display the acreage of the wetland polygon

2. Ratio Wetland Area: Watershed Area



This variable supports the following functions (Magee and Hollands 1998):

Storm and Flood-Water Storage
Modification of Stream Flow

Offsite Determination:

The ratio of wetland area to watershed area (contributing basin) may be obtained by dividing the acreage of the wetland polygon by the acreage of the watershed which flows to the wetland (Figure 2). This variable may be autopopulated by the database for some projects.

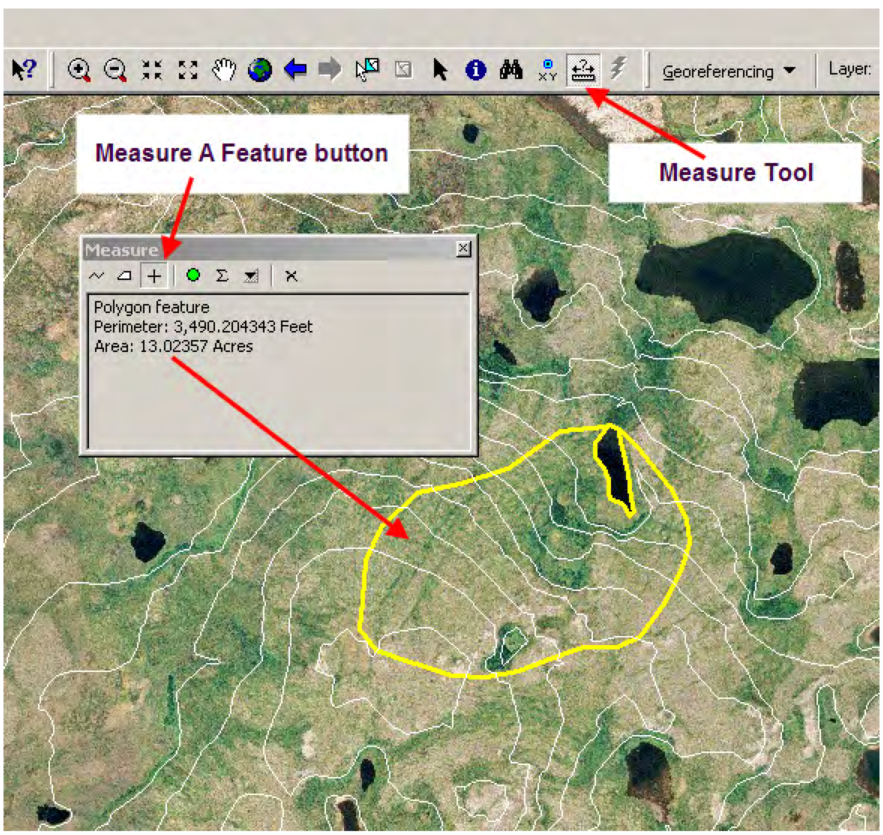
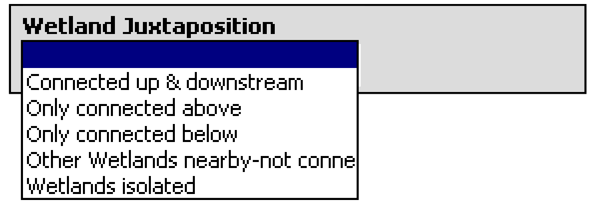


Figure 2. The area of any polygon (e.g., the contributing basin) can be measured using the Measure Tool. After opening the tool and clicking on the Measure a Feature button, click in the polygon. In this example, the contributing basin is approximately 13 acres in size

3. Wetland Juxtaposition

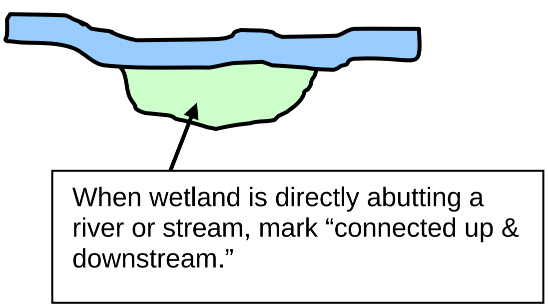


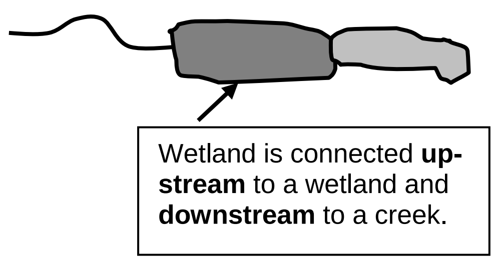
This variable supports the following functions (Magee and Hollands 1998):

Contribution to Abundance and Diversity of Wetland Vegetation
Contribution to Abundance and Diversity of Wetland Fauna

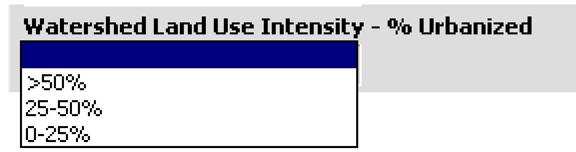
Offsite Determination:

Use digital mapping data, including contour and stream layers, to determine the hydrologic relationship between the target wetland and adjacent or nearby wetlands and streams. See diagrams below:





4. Watershed Land Use



This variable supports the following function (Magee and Hollands 1998):

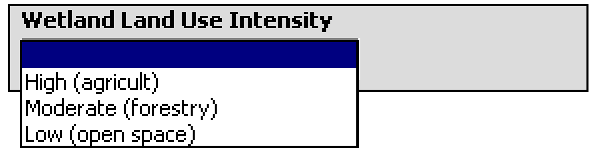
Contribution to Abundance and Diversity of Wetland Fauna

Offsite Determination:

Consult recent aerial photography to determine the percentage of the watershed that has been urbanized (Figure 3). A diverse array of land use modifications are included when assessing this variable. Examples include: agriculture, forestry, industry, residential development, and modifications to support ski resorts or other recreational uses.

Figure 3. More than 50% of the watershed of the target wetland has been urbanized (Wasilla, Alaska). Land use intensity is high.

5. Wetland Land Use



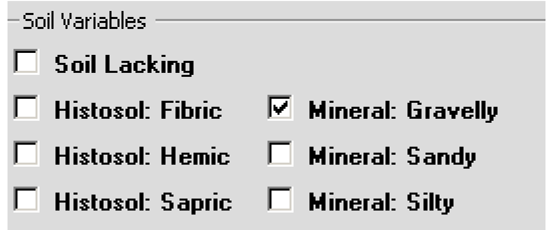
This variable supports the following functions (Magee and Hollands 1998):

Contribution to Abundance and Diversity of Wetland Fauna
Modification of Water Quality
Export of Detritus

Offsite Determination:

Consult recent aerial photography to determine the intensity of land use within the wetland (Figure 3). High intensity impacts include activities that remove natural vegetation and modify the hydrology and soils. For example, industrial, commercial, or residential development, or intense agriculture. Moderate land use includes activities which may modify natural vegetation but do not entirely replace it and which has left the hydrology and soils relatively undisturbed. For example, grazing and forestry.

Soil Variables



1. Soil Type

This variable supports the following functions (Magee and Hollands 1998):

Modification of Groundwater Recharge
Modification of Groundwater Discharge
Modification of Water Quality
Export of Detritus
Modification of Stream Flow

Offsite Determination:

To determine soil texture offsite, consider the following polygon features: evidence of disturbance and depositional events, vegetation type, slope, aspect, landform position, and hydrologic regime. Fibric and hemic soil organic matter is most common in areas where decomposition rates are slow, i.e., in soils underlain by permafrost and/or in soils with low oxygen levels (hypoxia). In areas of discontinuous permafrost, look for features that may indicate cold soil microclimates, e.g., N-facing slope, spruce canopy, lack of riparian features. Hypoxia is common in flooded soils. Indicators of flooding include concave landform, low topographic gradient, visible inundation on aerial imagery, and the presence of certain vegetation types, such as Tussock Tundra.

Additional supporting information may be obtained by reviewing data from nearby, similar field plots. If necessary, the plant community report function (Figure 4) may be utilized to view the frequency of different soil types and typical organic soil depths reported in comparable project wetlands. The report filters can be used to exclude dissimilar wetlands (Appendix B).

To indicate the presence of a histic epipedon, select two of the soil variables, one from the mineral soil category and the other from the organic soil category.

Soil Characteristics:

Characteristic	Range	Average	Std Dev	Count
Depth of Organic Material	0 - 7"	2.5"	2.5"	12

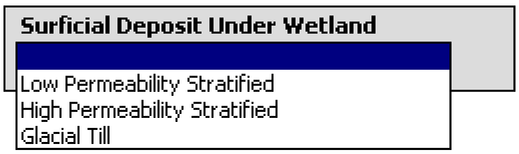
Field Drainage Class(es) & Taxonomic Class:

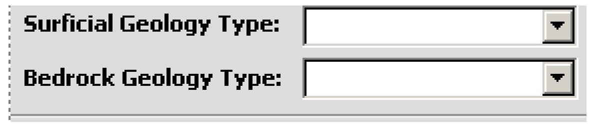
Taxonomic Class	Number of Records
Aeric Cryaquepts	1
Aquic Dystrocryepts	1
Oxyaquic Cryorthents	1
Typic Cryaquents	1
Typic Cryaquepts	3
Typic Fluvaquents	5

Figure 4. The Plant Community Report Function will display select soil data reported during onsite characterization of project wetlands.

Hydrologic Variables

1. Surficial Deposit Under Wetland





This variable supports the following functions (Magee and Hollands 1998):

Modification of Ground Water Recharge
Modification of Ground Water Discharge
Modification of Stream Flow

Offsite Determination:
Use digital mapping with surficial geology layer if available. Surficial geology maps/ reports may be available for some project areas in hard-copy form. If no collateral data are available, use the following general guidelines:

- Mark **glacial till** for landscape features that result from the direct deposit of unsorted glacial material. Features include moraine (terminal, lateral, medial and ground), drumlins, and kettle terraces.

- Mark **high permeability stratified** for sites on floodplains, river terraces and landforms associated with glacio-fluvial processes such as outwash plains, outwash terraces, outwash fans, meltwater channels, kames, and eskers.

- Mark **low permeability stratified** for glacio-lacustrine deposits and other landscape positions and landforms not associated with till deposits and glacio-fluvial processes.

2. Micro-Relief of Wetland Surface

Micro-Relief of Wetland Surface

Pronounced >45cm (17.7 in)
Well-developed 15-45cm (5.9-17.7 in)
Poorly Developed <15cm (5.9in)
Absent

This variable supports the following functions (Magee and Hollands 1998):

Modification of Ground Water Recharge
Modification of Ground Water Discharge
Modification of Stream Flow
Storm and Flood-Water Storage
Contribution to Abundance and Diversity of Wetland Fauna

Offsite Determination:

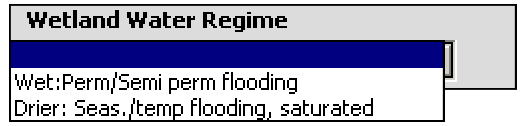
Large hummocks or tussocks may be evident in aerial photography (Figure 5). The Plant Community Report function can be used to display microtopographic data collected during assessment of plots with similar characteristics (Figure 6, Appendix B).

Figure 5 Large hummocks visible on aerial photography, southwest Alaska. The scale of this image is approximately 1:1,200.

MicroTopography	Count	Percent
	1	3.2 %
Concave	1	3.2 %
Flat	6	19.4 %
Hummocky (large)	1	3.2 %
Hummocky (moderate)	11	35.5 %
Hummocky (small)	7	22.6 %
Tussocks (moderate)	1	3.2 %
Undulating	3	9.7 %

Figure 6. The Plant Community Report Function will display microtopographic data recorded during onsite characterizations of project wetlands. The report may be specified to include data from plots with a specific set of environmental, location, and vegetation criteria.

3. Wetland Water Regime



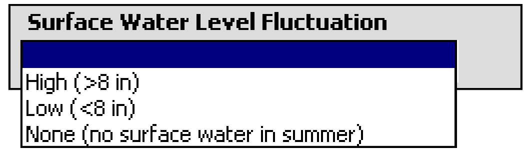
This variable supports the following functions (Magee and Hollands 1998):

Modification of Ground Water Recharge
Modification of Ground Water Discharge
Modification of Stream Flow
Storm and Flood-Water Storage
Export of Detritus
Contribution to Abundance and Diversity of Wetland Fauna

Offsite Determination:
In some projects, this variable can be auto populated because water regimes are included in the NWI code that is assigned to each polygon during the photo interpretation coding phase. Definitions and guidance for the water regimes are included in Appendix C.

Indicators of a "wet" water regime, including standing water, may be visible on aerial imagery. Prolonged flooding is more probable in areas dominated by obligate wetland plants, underlain by low permeability soils, and/or situated in low gradient, concave features.

4. Surface Water Level Fluctuation



This variable supports the following functions (Magee and Hollands 1998):

Modification of Ground Water Recharge
Modification of Steam Flow
Storm and Flood-Water Storage

Offsite Determination:

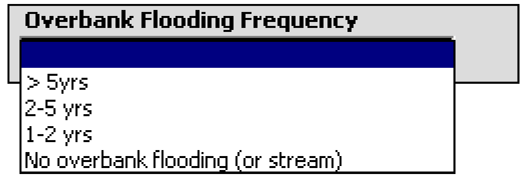
In general, surface water level fluctuation can be correlated with water regime designations for projects that have included NWI classification in the mapping geodatabase:

The Surface Water Fluctuation should be set to “none” for those polygons that have been assigned an NWI status of “saturated”. For those polygons assigned the NWI codes “temporarily flooded”, “seasonally flooded”, “semipermanently flooded”, or “permanently flooded” use the following *general* guidance to select between “high” or “low” surface water fluctuation.

- Select “**high**” for low gradient (<2% slope) wetlands, and “**low**” for high gradient (≥2% slope) wetlands.

- If a wetland is at the bottom of a depression with a slope of 0%, Select “**low**” for wetlands in shallow basins (e.g., slight depressions), and “**high”** for deep basins (e.g., kettles).

5. Overbank Flooding Frequency



This variable supports the following function (Magee and Hollands 1998):

Storm and Flood-Water Storage
Modification of Stream Flow

Offsite Determination:

In general, "**No overbank flooding**" should be marked for most slope and depressional wetlands unless adjacent open water is visible on aerial photography. Flat HGM wetlands may be on the periphery of, or surrounded by, a floodplain landform and may have an overbank flooding return of **>5 yrs**.

An interval category should be applied to all riverine and lacustrine fringe HGM wetlands. Use best professional judgment based on landscape position, slope, stream type, vegetation class, and flooding evidence on aerial photos (e.g., flooding debris or sediment) in combination with viewing how this variable was scored during field visits to nearby similar wetlands.

6. Evidence of Sedimentation

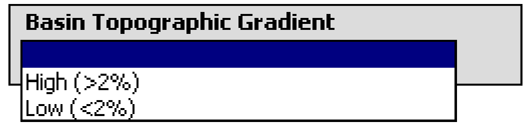
This variable is a direct indicator of function for the “Modification of Water Quality” function (Magee and Hollands 1998)

Offsite Determination:

If soil survey information is available for the project area, consult this source to determine if the wetland is in an area mapped as **fluvaquent soil.**

Review aerial photography for evidence of fluvial deposits. Only fluvial sediment (e.g., particulates settling from floodwater) is considered when evaluating this variable. Data for nearby field plots can be examined to determine the local prevalence of sedimentation and fluvaquent soils. Best professional judgment should be used in applying this evidence to the target wetland.

7. Basin Topographic Gradient



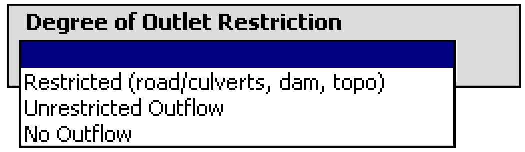
This variable supports the following functions (Magee 1998):

Storm and Flood-Water Storage
Modification of Stream Flow

Offsite Determination:

For some projects, this variable may be autopopulated. If this field has not been autopopulated, consult the project geodatabase to view the topographic GIS layer. A 2% slope over a length of 100 feet has an elevation rise of 2 feet . A 2% slope over a length of 500 feet has an elevation rise of 10 feet. In Riverine HGM wetlands, the slope is measured parallel to the stream channel.

8. Degree of Outlet Restriction



This variable supports the following functions (Magee and Hollands 1998):

Storm and Flood-Water Storage
Modification of Stream Flow
Modification of Water Quality
Export of Detritus

Offsite Determination:

This field may be autopopulated and uneditable for some projects. Review automated entries for accuracy.

If this field has not been autopopulated, assign an appropriate value. Restricted outflow can be caused by human-induced events (e.g., roads, culverts, and dams) or natural events (log jams, beaver activity, and landslides). A narrow "pinched" outlet formed by topographic features can also be considered "restricted." The aerial photography on the project geodatabase should be examined to determine if these conditions and features are present (Figure 7).

If "None" is checked for the Inlet/Outlet Class variable (see following page), "No outflow" must be checked for the Degree of Outlet Restriction variable.

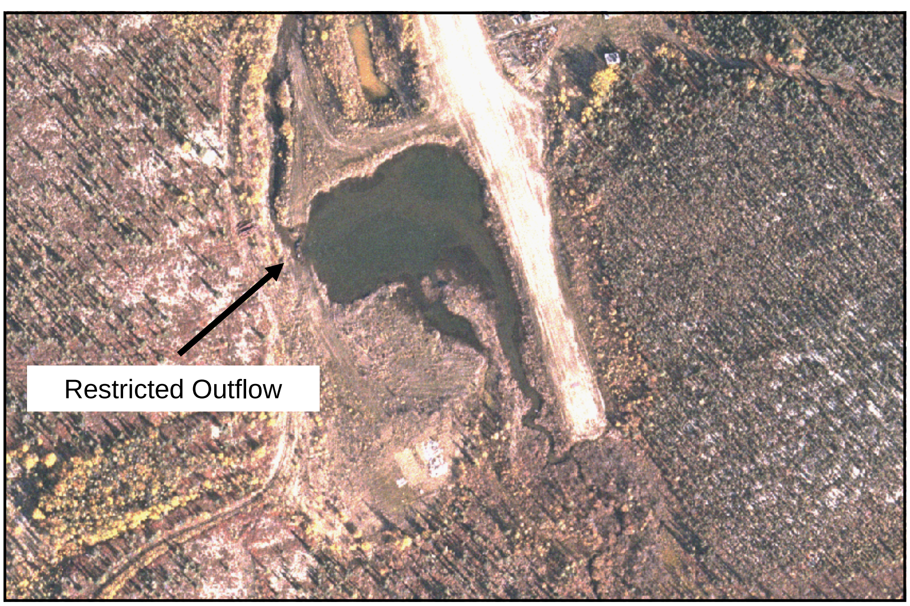
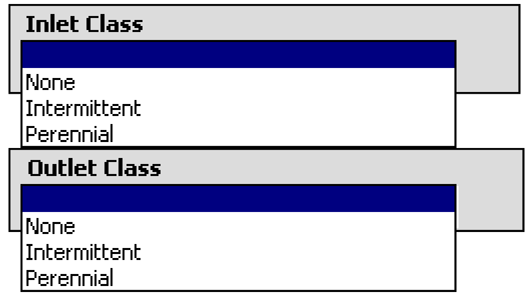


Figure 7. Outflow from pond/wetland complex restricted by placement of fill material in stream floodplain, interior Alaska. The scale of the image is approximately 1:2,500.

9. Inlet / Outlet Class



The Inlet/Outlet Class variable is used as a direct indicator of function and direct indicator of disfunction in the "Modification of Ground Water Discharge" and "Modification of Ground Water Recharge" functions (Magee and Hollands 1998). The variable is used as a primary indicator in the following functions:

Modification of Stream Flow
Storm and Flood-Water Storage
Modification of Water Quality
Export of Detritus

Offsite Determination:

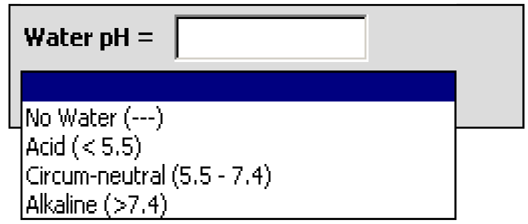
This field may be autopopulated and uneditable for some projects. Review this entry for accuracy.

If this field has not been autopopulated, examine the project geodatabase, including contour and stream layers, to determine if the subject wetland has an inlet(s) and/or outlet(s). Detailed guidance on identifying these features on aerial photography is presented in Appendix D.

Note:

- Adjacency to a stream or river does not necessarily mean that an inlet or outlet is present.
- A seep or spring that begins within the assessed polygon or on the border does not constitute an inlet.
- Use best professional judgment when deciding if inlets or outlets should be marked. For example, if a single small outlet (rivulet) exits a 100-acre assessment polygon, it is probably not warranted to check an "outlet box."
- If "none" is checked for Outlet, "No outflow" must be checked for the Degree of Outlet Restriction variable.

10. Water pH



This variable supports the following functions (Magee and Hollands 1998):

Modification of Ground Water Discharge
Modification of Ground Water Recharge
Modification of Stream Flow

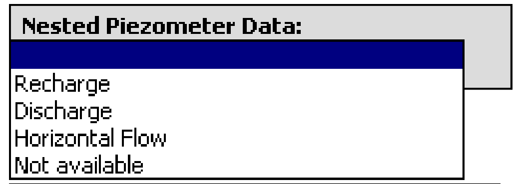
Offsite Determination:

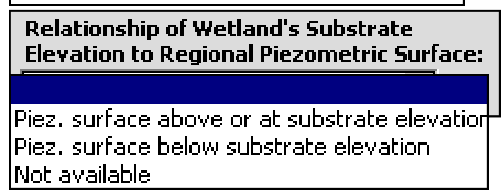
Since the definition of a wetland implies at least periodic soil saturation, the option "No Water" should not be chosen for Offsite Functional Assessments.

If an adjacent polygon with the same assigned HGM class has a recorded pH, use this value for the target wetland. In riverine wetlands, if nearby (0.5 miles), similar riverine field plots are not available, use the nearest pH value measured in the stream/ river. In wetlands where the hydrology is dominated by an adjacent pond or lake, use the waterbody pH values obtained in the field for the target polygon.

In general, wetlands supported primarily by groundwater will be characterized by a higher pH (circumneutral or alkaline) while those supported by rainwater will be characterized by a lower pH (circumneutral or acidic). If necessary, you may determine the local range of pH values by referring to field data from nearby features that are likely to be dominated by groundwater (e.g., seeps, springs) or by rainwater (seasonal ponds).

11. Nested Piezometer Data and Relationship of Wetland's Substrate Elevation to Regional Piezometric Surface





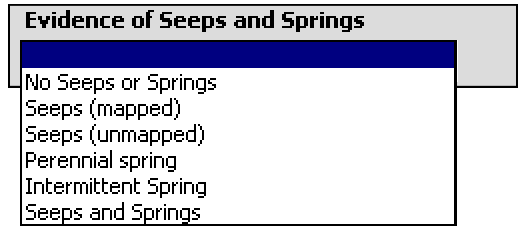
Magee and Hollands (1998):

These variables are used (if piezometer data is available) as direct indicators of function and direct indicators of disfunction in the "Modification of Ground Water Discharge" and "Modification of Ground Water Recharge" functions.

Offsite Determination:

Piezometers are small diameter wells designed to read water table elevations. These data are not likely to be available for most project areas. If available, separate guidance will be issued for interpreting and using the data for assessing groundwater recharge and groundwater discharge wetland functions. Mark "**Not Available**" if no specific guidance is provided.

12. Evidence of Seeps and Springs



Magee and Hollands (1998):

This variable is used as a direct indicator of function in the “Modification of Ground Water Discharge” function, and a direct indicator of disfunction in the “Modification of Ground Water Recharge” function.

Offsite Determination:

The seeps or springs should be within or on the edge of a polygon being assessed. Evidence of seeps and springs is often visible on aerial photographs. These features are most common on slopes where there is a gradient change, or near the base of toe slopes and bluffs. There is often a distinct vegetation change from a drier plant community above a seep zone to a much wetter community downslope (Figure 8). In general, seeps are characterized by discharge along a horizontal zone. Springs discharge water from a point. Some springs are large enough to be directly seen on typical project area aerial photography.

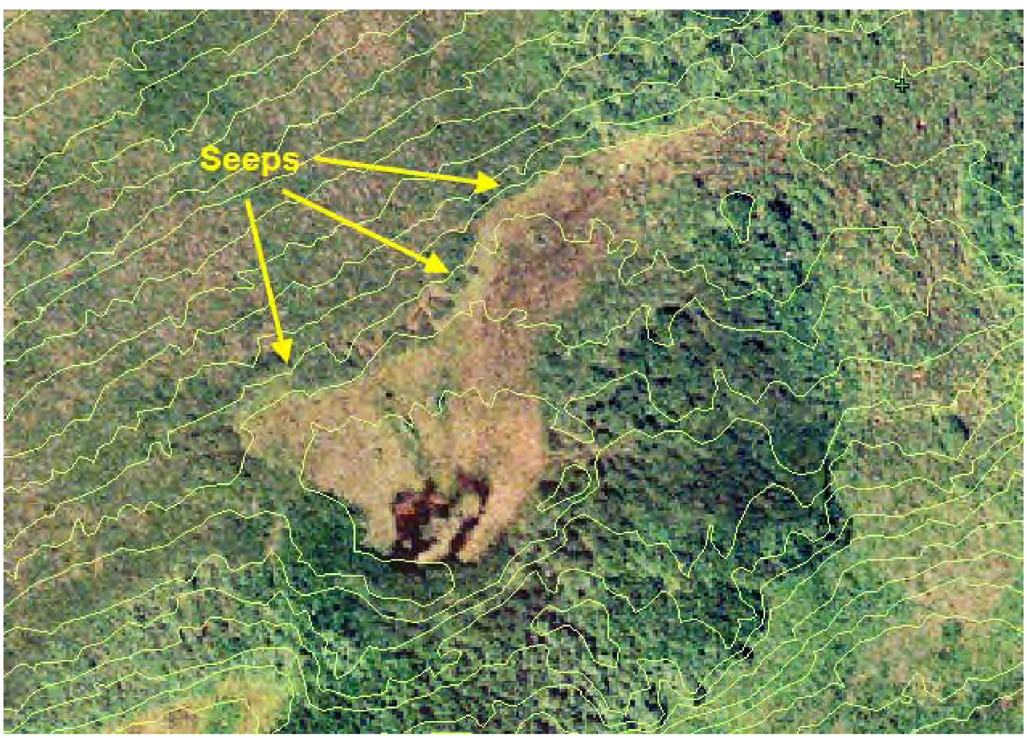
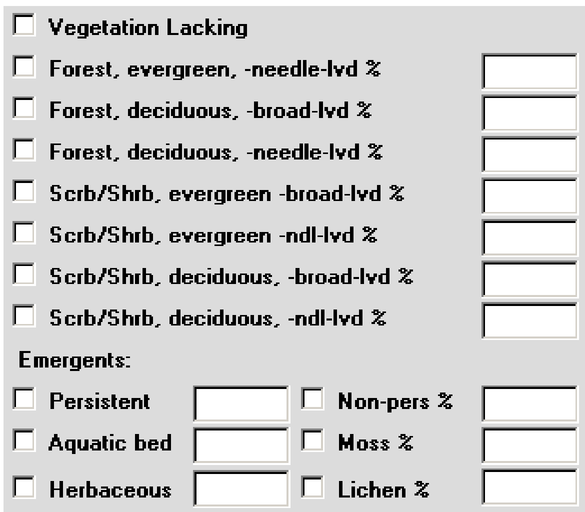


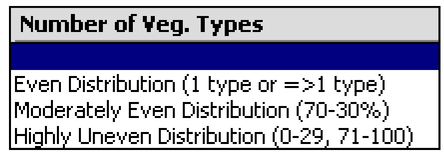
Figure 8. Seeps located along the upper edge of wet meadow area (southwest Alaska) occur where there is a change in slope gradient. Areas upslope of wet meadow are predominately non-wetland. Scale of image is approximately 1:1,100.

Vegetation Variables

Primary Vegetation Types

1. Number of Vegetation Types and Relative Proportions





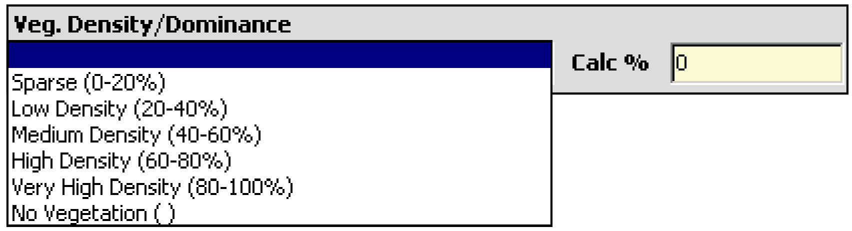
These variables support the following function (Magee and Hollands 1998):

Contribution to Abundance and Diversity of Wetland Fauna
Modification of Water Quality

Offsite Determination:
More than one primary vegetation type should be checked if site photos and/or aerial photography indicate the presence of secondary vegetation types within the polygon boundaries. By convention, all ericaceous shrubs, even ones that are evergreen, are considered “deciduous, broad-leaved, shrubs” for this variable.

The sum of the percent cover values must add to 100%.

2. Vegetation Density/Dominance



This variable supports the following functions (Magee and Hollands 1998):

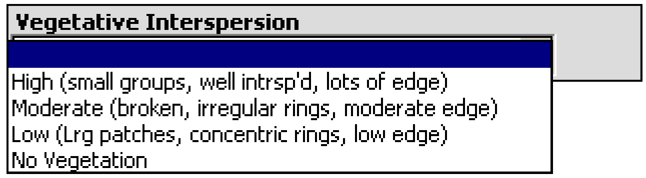
Storm and Flood-Water Storage
Modification of Stream Flow
Export of Detritus
Contribution to Abundance and Diversity of Wetland Vegetation

Offsite Determination:
The value chosen for the Vegetation Density/Dominance variable may not exceed the value displayed in the field labeled “Calc %”. The calc % value is the sum of the *absolute* percent cover values in the vegetation table (overlapping foliage is counted twice). The value associated with the Vegetation Density/Dominance variable represents the portion of the polygon covered by vegetation as viewed from above.

The percent cover of bare ground in field plots has not been consistently included among vegetation data collected by field personnel. Thus, if “BARE” appears in the auto-populated vegetation table, the corresponding percent cover value should be considered a minimum average percentage of bare ground.

Examine aerial imagery and/or site photos for evidence of onsite disturbance, rock, or open water. If these are absent, recall that most undisturbed freshwater wetland plant communities in the current project areas have a very high density of vegetation.

3. Vegetation Interspersion



This variable supports the following function (Magee and Hollands 1998):
Contribution to Abundance and Diversity of Wetland Fauna

Offsite Determination:
Consult aerial imagery and site photographs to assess the degree of interspersion evident among the community types checked for the vegetation variable “Primary Vegetation Types” (Figure 9).

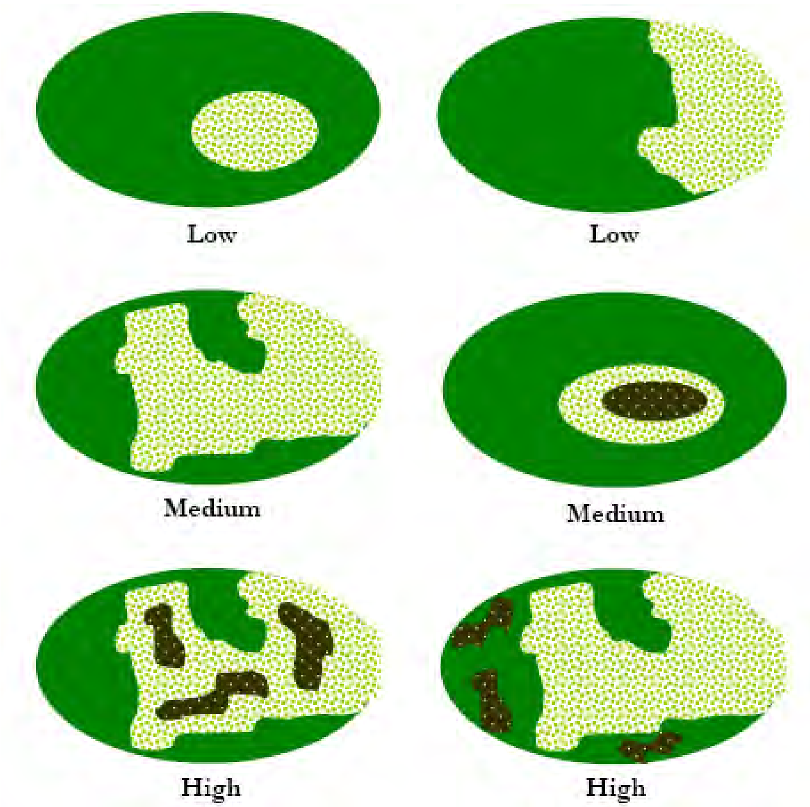
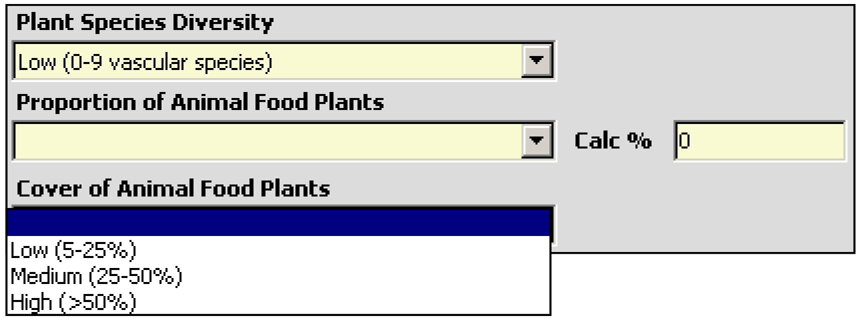


Figure 9 Examples of levels of interspersion in polygons comprised of 2-3 vegetation types. *(from CRAM Depressional Model 5.0.2)*

4. Plant Species Diversity and Proportion of Animal Food Plants



These variables support the following functions (Magee and Hollands 1998):

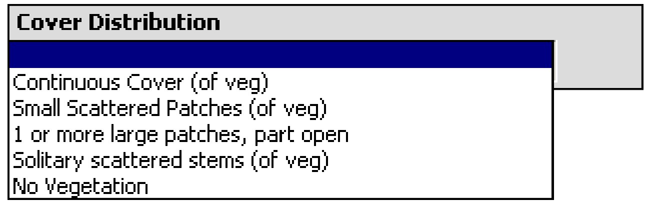
Plant Species Diversity
Contribution to Abundance & Diversity - Wetland Vegetation

Animal Food Plants
Contribution to Abundance & Diversity - Wetland Fauna (**Secondary)

Offsite Determination:
The database will autopopulate uneditable responses to these two variables. These entries are based on field data collected in plots within the same watershed and characterized by the same vegetation and HGM types as the target polygon.

*** Secondary variables are not currently included in the numerical functional assessment model.*

5. Cover Distribution



This variable supports the following function (Magee and Hollands 1998):

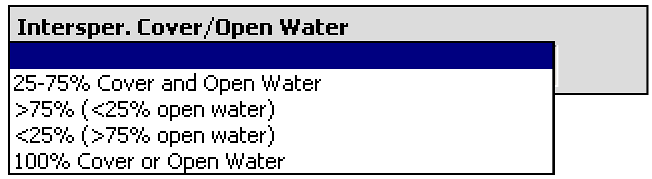
Modification of Water Quality

Offsite Determination:
For current projects, this variable is assessed at the scale of a vole. To select the appropriate response, review aerial imagery and Cover Distribution field data obtained from nearby plots with the same vegetation type and hydrologic regime as the target polygon.

The response chosen for this variable must be consistent with the response to the variable, Vegetation Density/Dominance. For example, if Vegetation Density/Dominance is “very low”, “Continuous Cover” would be an inappropriate response to the Cover Distribution variable.

The percent cover of bare ground and standing water in field plots has not been consistently included among vegetation data collected by field personnel. Thus, if “BARE” or “WATER” appears in the auto-populated vegetation table, the corresponding percent cover values should be considered minimum average percentages.

6. Interspersion of Vegetation Cover and Open Water



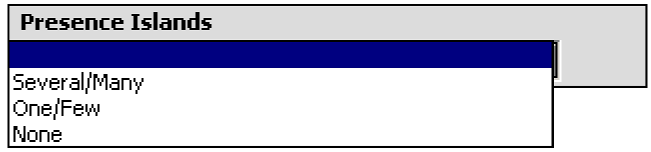
This variable supports the following function (Magee and Hollands 1998):

Contribution to Abundance and Diversity of Wetland Fauna

Offsite Determination:
If “No Water” has been selected for the variable “Surface Water Fluctuation” or the polygon hydrologic regime has been designated as “saturated”, then select “100% Cover” for this variable. Otherwise, consult aerial imagery to assess the degree of interspersion evident among vegetation and inclusions of open water. Standing water is more likely in low-gradient, concave landforms.

The percent cover of water in field plots has not been consistently included among vegetation data collected by field personnel. Thus, if “water” appears in the auto populated vegetation table, the corresponding percent cover value should be considered a minimum average percentage.

7. Presence of Islands



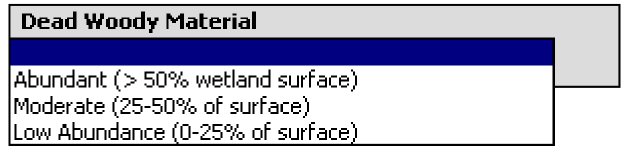
This variable supports the following function (Magee and Hollands 1998):

Contribution to Abundance & Diversity of Wetland Fauna (** Secondary variable)

Offsite Determination:
Islands are only evaluated for waterbodies, including rivers, streams, lakes, seasonal and perennial ponds. This variable is used to evaluate wildlife habitat functions, primarily the potential for waterfowl nesting areas protected from predators such as fox. Islands include upland areas, nonvegetated areas (e.g., temporarily flooded gravel bars), and persistent wetland vegetation occurring within bodies of water. Beaver lodges can be an island. This variable generally can be readily assessed by viewing aerial imagery. Islands in waterbodies also may be depicted in site photographs from the shoreline or surrounding ridgetops.

*** Secondary variables are not currently included in the numerical functional assessment model.*

8. Dead Woody Material



This variable supports the following functions (Magee and Hollands 1998):

Storm and Flood-Water Storage
Modification of Stream Flow

Offsite Determination:
With the current percent cover ranges for dead woody material, few sites on current projects will have more than "**low abundance**." In general, if more than 25% of the wetland surface is covered with dead woody material, this will be observable on typical project area aerial photography. This variable measures standing and fallen trunks, stems, and branches of woody plants

References

Magee, D.W, and G.G.Hollands. 1998. A Rapid Procedure for Assessing Wetland Functional Capacity Based on Hydrogeomorphic (HGM) Classification. Berne, NY: Association of State Wetland Managers.

APPENDIX A

Onsite Guidelines for Completing the Functional Assessment Page

MISC. FACTORS

Answer based on personal knowledge of the area. This will ultimately be updated through the GIS.

☐ Public Ownership ☐ Private
☐ Wildlife Management Area
☐ Fisheries Management Area
☐ Historic/Archaeological Area
☐ Designated Protected Wetland
☐ Documented Habitat for Listed Species
☐ Regionally Scarce (< 5%) Wetland
☐ Recreational Use Area
☐ Subsistence Use Area %Cov =

LANDSCAPE VARIABLES

Estimate. GIS will update from digital mapping.

Size: ~ ______ (acres) _______(GIS)
☐ Small (<10 ac)
☐ Med. (10 -100 ac)
☐ Large (>100 ac)

Ratio of This Wetland Area to Total Watershed Area (GIS)_____ %

Estimate: Final will be calculated by GIS.
☐ High (>10%) ☐ Low (≤10%)

Wetland/Water Juxtaposition

A wetland or Water of the US directly abutting subject polygon upslope or down slope, including intermittent streams, constitutes a connection.
☐ Connected up & downstream
☐ Only connected above
☐ Only connected below
☐ Other wetlands nearby-not connected
☐ Wetland isolated

Watershed Land Use-% Urbanized

☐>50% ☐>25-50% ☐ 0-25%

Wetland Land Use Intensity

☐ High (agricult) ☐ Moderate (forestry)
☐ Low (open space)

SOIL VARIABLES

Based on dominant texture in upper 16" if mineral. If sandy loam, it's sandy. If finer (e.g., loam), it's silty (no clays!). If Histic Epipedon, Select 2.
☐ Soil lacking
☐ Fibric ☐ Gravelly
☐ Hemic ☐ Sandy
☐ Sapric ☐ Silty

Surficial Geology Type: *From GIS*

HYDROLOGIC VARIABLES

Surficial Deposit Under Wetland

GIS Data Take Precedence Where Available
☐ Low permeability stratified
☐ High permeability stratified
☐ Glacial till Compact? ☐

Micro-Relief of Wetland Surface

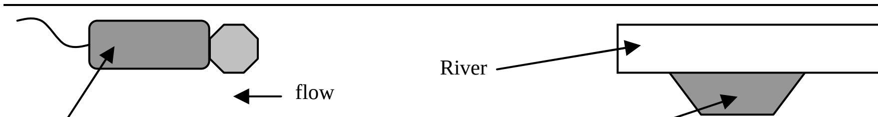
= Microtopography on pg 1 of form
☐ Pronounced >45 cm (>17.7 ")
☐ Well developed 15-45 cm (5.9-17.7")
☐ Poorly developed <15cm (<5.9 ")
☐ Absent

Onsite Guidelines for Completing the Functional Assessment Page

Permission is required to gain access to private lands. Some private lands (e.g., Native land) may require accompaniment by a local Native representative.

Visually estimate the size of the polygon that will contain the field plot using observation and field maps/aerial photographs. See Size Estimate handout.

Estimation of wetland acres being assessed vs. the watershed which flows to the wetland (contributing basin). The "high" box will rarely be checked.



Wetland is connected **upstream** to a wetland and **downstream** to a creek.

When wetland is adjacent to a river or stream, check "connected up & downstream."

In non-urban areas, "0-25%" is commonly the only box that should be checked.

High intensity impacts include activities that remove natural vegetation and modify the hydrology and soils (e.g., industrial, commercial, or residential development, or intense agriculture). Moderate land use includes activities which may modify natural vegetation but do not entirely replace it and which has left the hydrology and soils relatively undisturbed (e.g., grazing and forestry).

If histosol, check one box
If mineral soil with organic surface horizon <8" thick, check one box.
If mineral soil with histic epipedon, check the dominant organic type and the dominant mineral type.

- Mark **glacial till** for landscape features that result from the direct deposit of unsorted glacial material. Features include moraine (terminal, lateral, medial and ground), drumlins, and kettle terraces.
- Mark **high permeability stratified** for sites on floodplains, river terraces and landforms associated with glacio-fluvial processes such as outwash plains, outwash terraces, outwash fans, meltwater channels, kames, and eskers.
- Mark **low permeability stratified** for glacio-lacustrine deposits and other landscape positions and landforms not associated with till deposits and glacio-fluvial processes.

Height category must match height class selected for microtopography on page 1 of the data form:

Pronounced = large
Well developed = moderate
Poorly developed = small

If "undulating" is marked on page 1, select a height class that represents the height of the mounds that form the undulating surface.

Wetland Water Regime (Cowardin) Non-Tidal: ☐ A ☐ B ☐ C ☐ F ☐ H Tidal: ☐ P ☐ N ☐ L Fresh Tidal: ☐ S ☐ R ☐ T ☐N	Select only one, even in areas that have distinct high and low areas. General Tips: The B regime is the most common code used in most large project areas. However, it is used less than the A and C modifiers in Riverine and Depressional HGM wetlands. Herbaceous wetlands on floodplains are usually A or C. Willow and/or alder on floodplains is usually A.
Surface Water Level Fluctuation Counts only the depth above ground surface. ☐ High (≥8") ☐ Low <8") ☐ None (no surface water in summer)	Look for any signs/evidence that standing water is present during the growing season. Evidence includes high-water marks, drift lines, water-stained leaves, landscape position in relation to nearby stream channel, sedimentation, etc. The "none" box is seldom applicable for Riverine HGM wetlands.
Overbank Flooding Frequency Return interval: Estimate based on presence of a stream or lake. ☐ > 5 yrs ☐ >2-5 yrs ☐ 1-2 yrs ☐ No overbank flooding (or stream/lake)	Use best professional judgment based on landscape position, stream type, vegetation class, flooding evidence, etc.
Evidence of Recent Sedimentation (transported by H20) ☐ No evidence ☐ Fluvaquent soil (or other ind'g deposits) ☐ Sediment observed on substrate	If "sediment deposits" are marked as present in Hydrology sections, "sediment observed on substrate" should be checked here. Fluvaquent soils are "new" soils that have been deposited by water.
Basin Topographic Gradient Same as slope of polygon. ☐ High (>2%) ☐ Low (≤2%)	The slope measurement is taken directly from the hydrology section. In Riverine HGM wetlands, the slope is measured parallel to the stream channel.
Degree of Outlet Restriction ☐ Restricted (road/culverts, dam, log jams) ☐ Unrestricted outflow ☐ No outflow	Restricted outflow can be caused by human-induced events (e.g., roads, culverts and dams) or natural events (log jams, beaver activity and landslides). A narrow "pinched" outlet formed by topographic features can also be considered "restricted."
Inlet/Outlet Class (polygon) Inlet or outlet is a channel or very wet swale with surface water at some time. This does not include diffuse overland/through-soil flow. A seep does not constitute an inlet. **Inlet** ☐ None ☐ Intermittent ☐ Perennial **Outlet** ☐ None ☐ Intermittent ☐ Perennial	Adjacency to a stream or river does not necessarily mean that an inlet or outlet is present. A seep or spring that begins within the assessed polygon or on the edge does not constitute an inlet. Use best professional judgment when deciding if inlets or outlet should be marked. For example, if a single small outlet (rivulet) exits a 100 acre assessment polygon, it is probably not warranted to check an "outlet box." If "none" is checked for Outlet, "No outflow" must be checked in Degree of Outlet Restriction section
Water pH = _______ Measured using a meter in standing water within the polygon; or where absent -- in the soil pit-or not measured. ☐ No water ☐ Acid <5.5 ☐ Circum-neutral 5.5-7.4 ☐ Alkaline >7.4	pH measurement comes directly from the Hydrology section.
Nested Piezometer Data ☐Not available (Field) – Possible GIS Update	Check the box unless data is provided.
Wetland's Substrate Elev. to Regional Piezometric Surface ☐ Not available (Field) – Possible GIS Update	Check the box unless data is provided.
Evidence of Seeps & Springs Observation or evidence of seep or spring, or even mild evidence of seep or spring (e.g., toe of slope that abruptly becomes wet) ☐ No seeps or springs ☐ Seeps (Mapped? Yes or No - *GIS*) ☐ Perennial spring ☐ Intermittent spring	The seep or spring should be within the polygon or **on** the edge of the polygon being sampled. In general, springs discharge water from a point. Seeps are characterized by discharge along a horizontal zone. If large enough, the seep or spring should be sampled as either a RW or SC based on the outflow of the water. For example, a SC photopoint should be selected if the outflow forms a channel.
Fish Present? ☐ ____________	Fish must be observed within the polygon being sampled. If you are assessing a floodplain wetland and see fish in the **adjacent** river channel, do not check "fish present."

VEGETATION VARIABLES

Primary Vegetation Types

Check >1 if inclusions of >1 dominant (canopy) form. If >1, include % of its cover of the polygon. Entire polygon must be one HGM class.

- ☐ Vegetation lacking
- ☐ Forest, evergreen, needle-lvd%_____
- ☐ Forest, deciduous, broad-lvd%_____
- ☐ Forest, deciduous, needle-lvd%____
- ☐ Scrb/shrb, evergrn, broad-lvd%_____
- ☐ Scrb/shrb, evergrn, needle-lvd%_____
- ☐ Scrb/shrb, decid,.broad-lvd %______
- ☐ Scrb/shrb, decid, needle-lvd%______

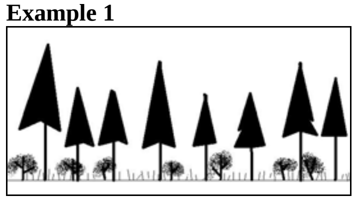
Emergents:

- ☐ Persistent %____ ☐Non-persis%___
- ☐ Aquatic bed %____ ☐ Moss% _____
- ☐ Herbaceous %____ ☐ Lichen% _____

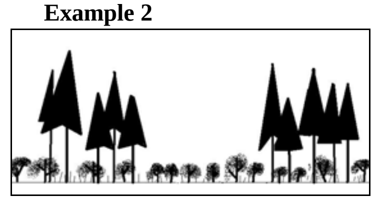
This item is **not** a checklist for the presence of strata. Estimate the percentage of the plot occupied by the primary vegetation type and, if applicable, by patches of subordinate vegetation type(s). The sum of the percentages within these boxes must add to 100. The minimum size requirement for a patch is 14ft (4.3m) diam. By convention, all ericaceous shrub vegetation types are considered Scrub/shrub, deciduous, broad-leaved.

In example 1, the trees are evenly space and there are no secondary vegetation type patches > 14 ft diameter. The forest wetland polygon is therefore 100% needle-leaved evergreen forested wetland (check that box **only**). In example 2, the forest wetland polygon consists of densely forested patches and shrub dominated patches ≥ 14 ft diameter. Forest patches comprise 60% of the plot area, while shrub patches comprise the remaining 40%. Two boxes should be checked: forest, evergreen, needle-leaves (60%) and scrub/shrub, deciduous, broad-leaved (40%).

Example 1



Example 2



Number of Veg. Types __ (chkd abve)

Based on % cover of types checked above.

- ☐ Even distribution (1 type =100%, 2 types = 45-55%, 3 types=30-35)
- ☐ Moderately even (30-44%, 56-70%)
- ☐ Highly uneven distribution (0-29,71-100)

This item records the number of boxes checked above, and the relationship of the % values checked above. In reference to Example 2 shown above, the "Number of Veg Types" is 2, and the 40% and 60% cover values are "moderately even."

Veg. Density/Dominance

100% minus bare ground or unvegetated water

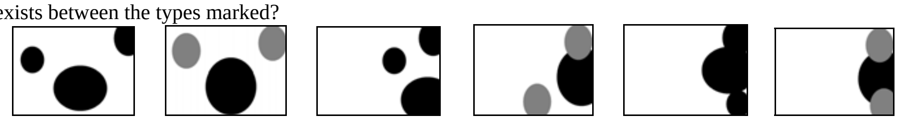
- ☐ Sparse (0-20%)
- ☐ Low density (>20-40%)
- ☐ Medium density (>40-60%)
- ☐ High density (>60-80%)
- ☐ Very high density (>80-100%)

This question is asking how much ground is vegetated vs. unvegetated.
Start with 100% and subtract out the cover of bare ground, rock, talus, unvegetated water.

Vegetative Interspersion (within plot)

- ☐ High (small groups, well intrsp'd, lots of edge)
- ☐ Moderate (broken irregular rings, mod edge)
- ☐ Low (Lrg patches, concentric rings, low edge)

This item is in reference to the boxes checked in the Primary Vegetation Type section. How much edge exists between the types marked?



High Interspers. 2 veg types	High Interspers. 3 veg types	Mod. Interspers. 2 veg types	Mod Interspers. 3 veg types	Low Interspers. 2 veg types	Low Interspers. 3 veg types

Plant Species Diversity

- ☐ Low (0-9 vascular species)
- ☐ Medium (10-18 vascular species)
- ☐ High (>18 vascular species)

Number of vascular species listed on page 1 in Vegetation section. **Note**: moss, lichen, and liverwort species are non-vascular and should not be included in total number.

Cover of Animal Food Plants

Estimate – Final Determined in GIS.

☐Low (5-25%) ☐Med (>25-50%) ☐ Hi (>50%)

Make your best estimate on the vegetation data collected or identified on site. This should be a quick visual assessment. For example, willow is an important browse species for moose. The plants database will calculate food values for all species listed at some future date.

Cover Distribution (based on vole)

- ☐ Continuous cover (of veg)
- ☐ Small scattered patches (of veg)
- ☐ 1 or more large patches, part open
- ☐ Solitary scattered stems (of veg)

Using the information from the density/dominance question above, does the vascular vegetation provide cover for a red backed vole? Moss and lichen is not considered cover. Add all open ground, open water, and areas dominated by mosses and lichens and have minimal vascular plant cover. Then answer the questions provided and check the most appropriate box.

Interspersion Cover/Open Water

- ☐ 25-75% veg & 25-75% open water
- ☐ >75% veg (<25% open water)
- ☐ <25% veg (>75% open water)
- ☐ 100% cover or open water

If open water is present (including intermittent streams, non-mappable channels, small pools and ponded depressions) then estimate water cover vs. vegetation cover. If all water or all vegetated, then answer 100% cover.

Water areas (dark) are exactly 25% of area

Presence of Islands (in water-bodies)

☐ Several/many ☐ One/few ☐ None

Islands are only evaluated for waterbodies, including rivers, streams, lakes, seasonal and perennial ponds. Islands include upland areas, nonvegetated areas (e.g., temporarily flooded gravel bars), and persistent wetland vegetation occurring within bodies of water. Beaver lodges can be an island.

Dead Woody Material (Rare at Pebble)

- ☐Moderate abundance(>25-50% of surface)
- ☐Low abundance (0-25% of surface)

Use the number ranges provided to record the amount of dead woody material in the polygon. This variable measures standing (snags) and fallen trunks, stems and branches of woody plants. Few sites will have more than "low abundance."

APPENDIX B
The Plant Community Report Function

The SCA Plant Community Reports may assist offsite evaluation of some functional assessment variables. However, these reports have limitations and should be used with caution. The user likely will find that best professional judgment, in combination with a review of photo imagery and data collected in neighboring plots, often is more effective and time-efficient than the Plant Community Reports.

The Plant Community Report display currently does not include response frequencies to variables on the Functional Assessment Tab. Thus, much of the field data collected by staff, including field data collected in Functional Assessment Plots, will not be summarized in the final Plant Community Report.

However, this resource may, at times, be useful when assigning characters to certain Functional Assessment variables. If other Offsite Functional Assessment procedures described in this document fail to assist the user to quickly determine the most appropriate response for a functional assessment variable, the Plant Community Report Function may provide valuable in-

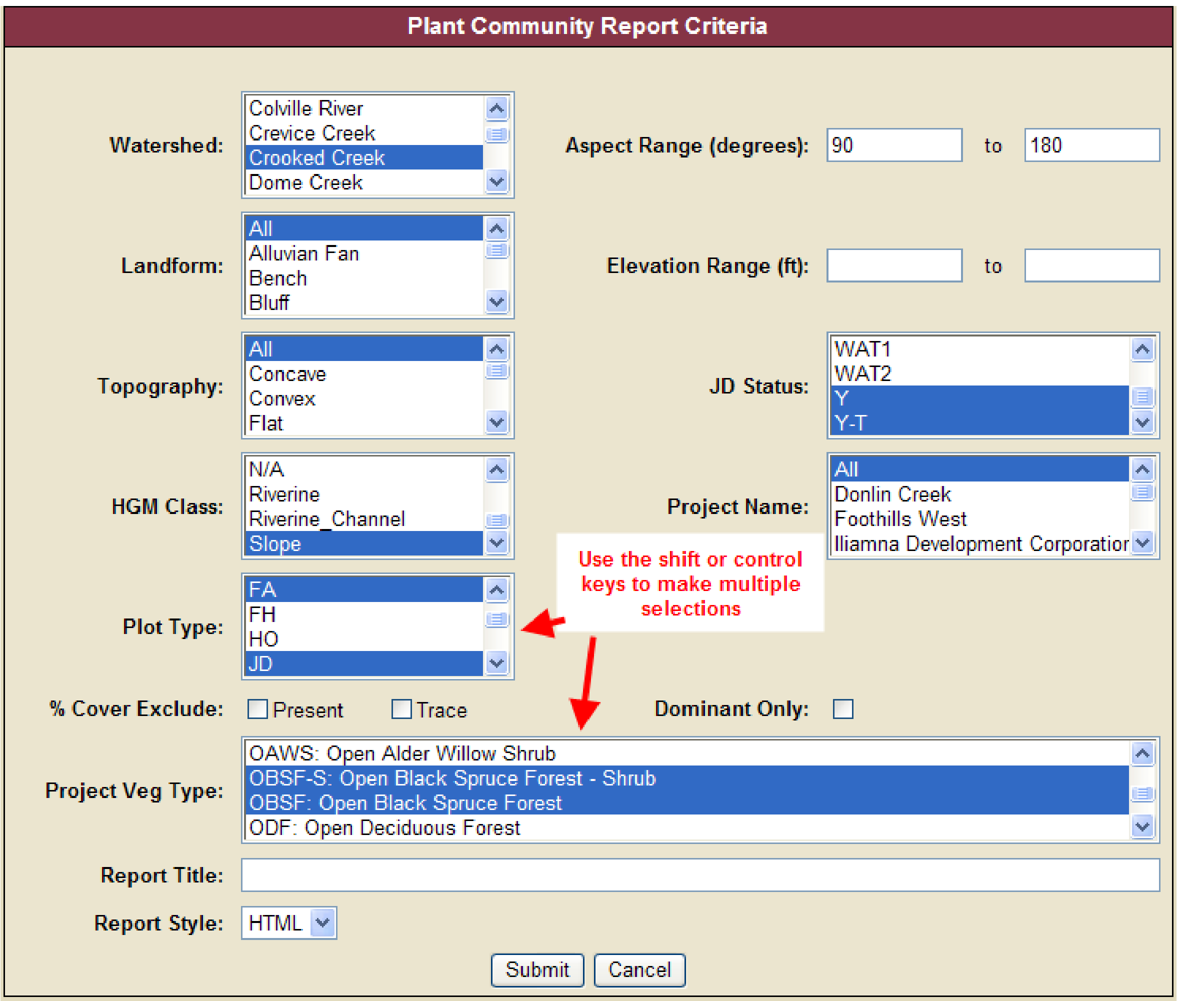


Figure B1. The field data used to compile the Plant Community Report may be restricted to comparable wetlands through judicious selection of multiple report criteria.

APPENDIX C

Water Regime Guidance

APPLICATION OF NON-TIDAL WATER REGIMES

SATURATED (B): The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.

General guidance: The saturated modifier is the most common water regime used in Alaska project areas. It is the typical water regime for hillside seeps and other hillside wetlands such as north-facing slopes dominated by black spruce. Bogs, muskegs, and the drier portions of fens are typically saturated. "Saturated " is less common than Temporarily Flooded and Seasonally Flooded in Riverine HGM wetlands.

TEMPORARILY FLOODED (A): Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. Plants that grow both in uplands and wetlands are characteristic of the temporarily flooded regime.

General guidance: The temporarily flooded modifier is commonly applied to shrub and forested wetlands on riverine floodplains, shrub dominated drainageways on hillsides, and depressions that are inundated for brief periods.

SEASONALLY FLOODED (C): Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

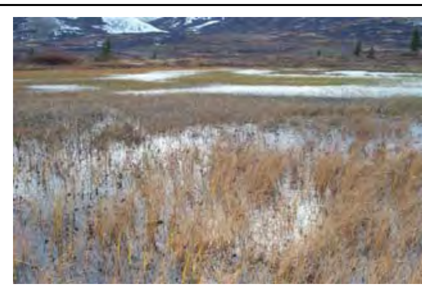
General guidance: The seasonally flooded modifier is commonly applied to emergent dominated wetlands on riverine floodplains, fens, shallow marshes, emergent dominated drainageways on hillsides, and many depressions that become dry part-way through the growing season.

SEMIPERMANENTLY FLOODED (F): Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

General guidance: The semipermanently flooded modifier is commonly applied to closed oxbows on riverine floodplains, deep marshes, shallow ponds, and fens with ponded water.

PERMANENTLY FLOODED (H): Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes.

General guidance: The permanently flooded modifier is commonly applied to deep marshes, deep ponds, other ponds dominated by floating or submerged vegetation, lakes, and perennial river channels.



Non-tidal Water Regimes as a percent of the growing season (approximately May 1 through October 3 – 156 days)

Water Regime	**Duration of Inundation (%)**	**Duration of Inundation (days)**
Permanently Flooded (H)	100	156+
Semi-permanently Flooded (F)	75-100	117 - 155
Seasonally Flooded (C)	25-75	39-116
Saturated (B)	Rarely inundated.	Rarely inundated.
Temporarily Flooded (A)	5-25	8-38

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

Systems and Subsystems — Classes Available for Each Subsystem

Systems and Subsystems		Classes Available for Each Subsystem
M - Marine		
1	Subtidal	RB, UB, AB, RF, OW
2	Intertidal	AB, RF, RS, US
E - Estuarine		
1	Subtidal	RB, UB, AB, RF, OW
2	Intertidal	AB, RF, SB, RS, US, EM, SS, FO
R - Riverine		
1	Tidal	RB, UB, SB, AB, RS, US, EM, OW
2	Lower Perennial	RB, UB, AB, RS, US, EM, OW
3	Upper Perennial	RB, UB, AB, RS, US, OW
4	Intermittent	SB
5	Unknown Perennial	RB, UB, AB, RS, US, OW
L - Lacustrine		
1	Limnetic	RB, UB, AB, OW
2	Littoral	RB, UB, AB, RS, US, EM, OW
P - Palustrine		
	No subsystems	

Water Regimes - Alaska Projects

Modifier	Code
Non-tidal Areas	
Saturated	B
Temporarily Flooded	A
Seasonally Flooded	C
Semipermanently Flooded	F
Permanently Flooded	H
Estuarine/Marine Areas	
Irregularly Flooded	P
Regularly Flooded	N
Subtidal	L
Fresh Tidal Areas	
Temporarily Flooded - Tidal*	S
Seasonally Flooded - Tidal*	R
Permanently Flooded - Tidal*	V

* These modifiers should be applied to freshwater areas that are irregularly flooded by tides. If the freshwater areas are regularly flooded by tides, the regularly flooded (N) modifier should be used.

Classes and Subclasses

AB - Aquatic Bed
- 1 Algal
- 2 Aquatic Moss
- 3 Rooted Vascular
- 4 Floating Vascular
- 5 Unknown Submergent**
- 6 Unknown Surface**

EM - Emergent
- 1 Persistent
- 2 Nonpersistent

FO - Forested
- 1 Broad-leaved Deciduous
- 2 Needle-leaved Deciduous
- 3 Broad-leaved Evergreen
- 4 Needle-leaved Evergreen
- 5 Dead
- 6 Deciduous**
- 7 Evergreen**

** Not included in Cowardin et al (1979). These terms were created specifically for National Wetlands Inventory mapping efforts.

ML - Moss/Lichen
- 1 Moss
- 2 Lichen

OW - Open Water**

RB - Rock Bottom
- 1 Bedrock
- 2 Rubble

RF - Reef
- 1 Coral
- 2 Mollusk
- 3 Worm

RS - Rocky Shore
- 1 Bedrock
- 2 Rubble

SB - Streambed
- 1 Bedrock
- 2 Rubble
- 3 Cobble/Gravel

SS - Scrub/Shrub
- 1 Broad-leaved Deciduous
- 2 Needle-leaved Deciduous
- 3 Broad-leaved Evergreen
- 4 Needle-leaved Evergreen
- 5 Dead
- 6 Deciduous**
- 7 Evergreen**

UB - Unconsolidated Bottom
- 1 Cobble/Gravel
- 2 Sand
- 3 Mud
- 4 Organic

US - Unconsolidated Shore
- 1 Cobble/Gravel
- 2 Sand
- 3 Mud
- 4 Organic
- 5 Vegetated

Special Modifiers

- b - Beaver
- d - Partly Drained
- f - Farmed
- d - Diked/Impounded
- r - Artificial
- s - Spoil
- x - Excavated

Coding Examples

P EM 1 C b
- P: Palustrine
- EM: Emergent
- 1: Persistent
- C: Seasonally Flooded
- b: Beaver

R 2 US A
- R: Riverine
- 2: Lower Perennial
- US: Unconsolidated Shore
- A: Temporarily Flooded

Mixing is restricted to one mixed class or subclass:

PFO4/SS1B	(mixed classes)
PSS1/EM1C	(mixed classes)
PSS1/4B	(mixed subclasses)
PFO4/2B	(mixed subclasses)

APPENDIX D

Mapping Conventions
for the
Assignment of Inlet/Outlet Classes

Mapping Conventions for the Assignment of Inlet/Outlet Classes

Introduction

These mapping conventions were developed to ensure consistency in the assignment of inlet/outlet categories to wetland map units (polygons). The wetland polygons are being identified by several individuals located in different offices. Discussions during the field season indicated that there were some differences in interpretation regarding how certain classes (e.g., perennial inlet) should be applied to wetlands in some landscape settings. Inconsistent interpretations are most likely to occur in complex systems such as broad riverine areas that consist of a mosaic of ponds, terraces, sloughs, and levees. Although these conventions provide guidelines and examples for most systems, emphasis is given to complex areas.

Riverine

Conceptually, it is possible to infer that all map units within a riverine system have an inlet and outlet since the primary source of water for the entire system is the main channel (perennial or intermittent). However, this approach does not differentiate the capacities that wetland units within the floodplain have to perform certain functions. Therefore, the assignment of inlet/outlet classes in these large systems should be based on the specific connectivity of the map unit to the main channel, the connectivity of the unit to other units, or the connectivity of the unit to systems outside of the riverine HGM class.

Many wetland units within riverine areas consist of a generally level terrace that is flooded by overbank flooding for brief periods (temporarily flooded). Although these areas may be adjacent to the main channel, they should be designated as "**No Inlet/No Outlet**" unless an obvious drainage channel is observed. Figure 1 shows several temporarily flooded wetland areas where the "**No Inlet/No Outlet**" designation would be applied. Islands lacking drainage channels would similarly be classified as "**No Inlet/No Outlet**" (Figure 2).

In many cases in riverine wetland map units, a single channel entering the polygon can be considered to be both an inlet and outlet. These channels facilitate flooding of the area when the water rises, and they allow the area to drain quickly following recession of the water level. Figure 3 shows a herbaceous riverine wetland with 3 channel networks entering the system. The "**Intermittent Inlet/Intermittent Outlet**" classification applies since these channels are dewatered during low flow periods.

Ox-bow ponds and sloughs representing abandoned channels exhibit the full range of connectivity through inlets and outlets. In Figure 4, the delineated wetland does not exhibit any inlet or outlet features and should be classified as "**No Inlet/No Outlet.**" Unlike the example shown in Figure 3 where a channel can be considered to be both an inlet and outlet, abandoned channel features are usually oriented along a slight gradient and can have an inlet feature at one end and an outlet feature at the other end (Figure 5).

Figure 6 illustrates a floodplain marsh located behind an abandoned beaver dam. The site has a perennial inlet coming from another wetland system and a perennial outlet draining into the main river channel.

Figure 1. Delineated riverine wetland areas should be classified as **"No Inlet/No Outlet."**

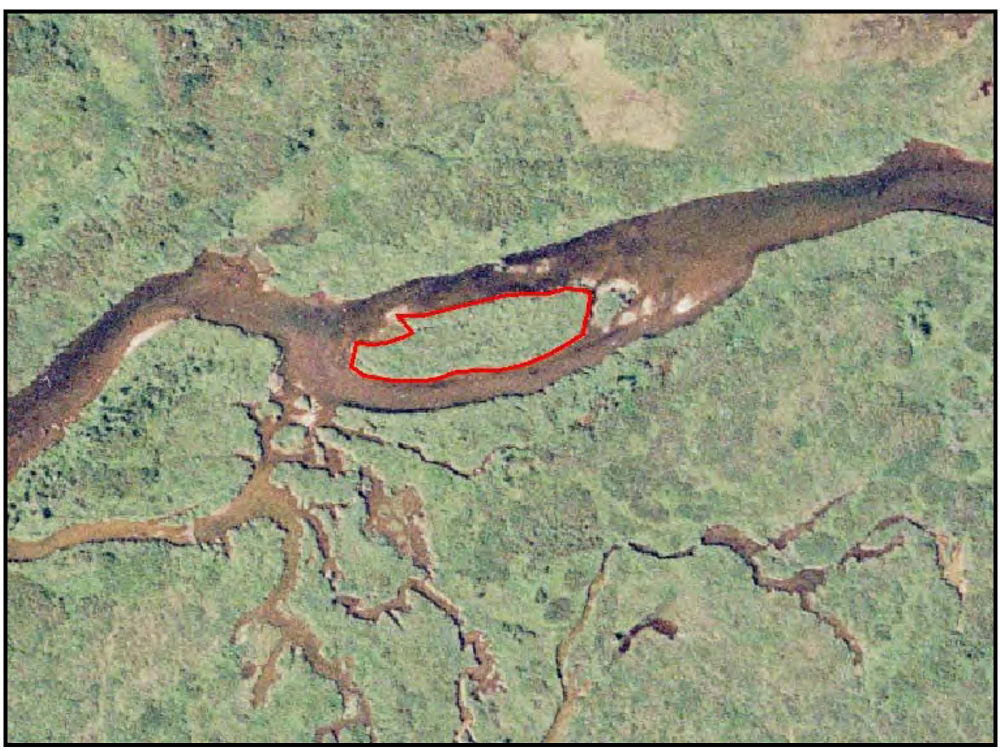


Figure 2. Island polygon contains no distinct drainages and should be classified as **"No Inlet/No Outlet."**

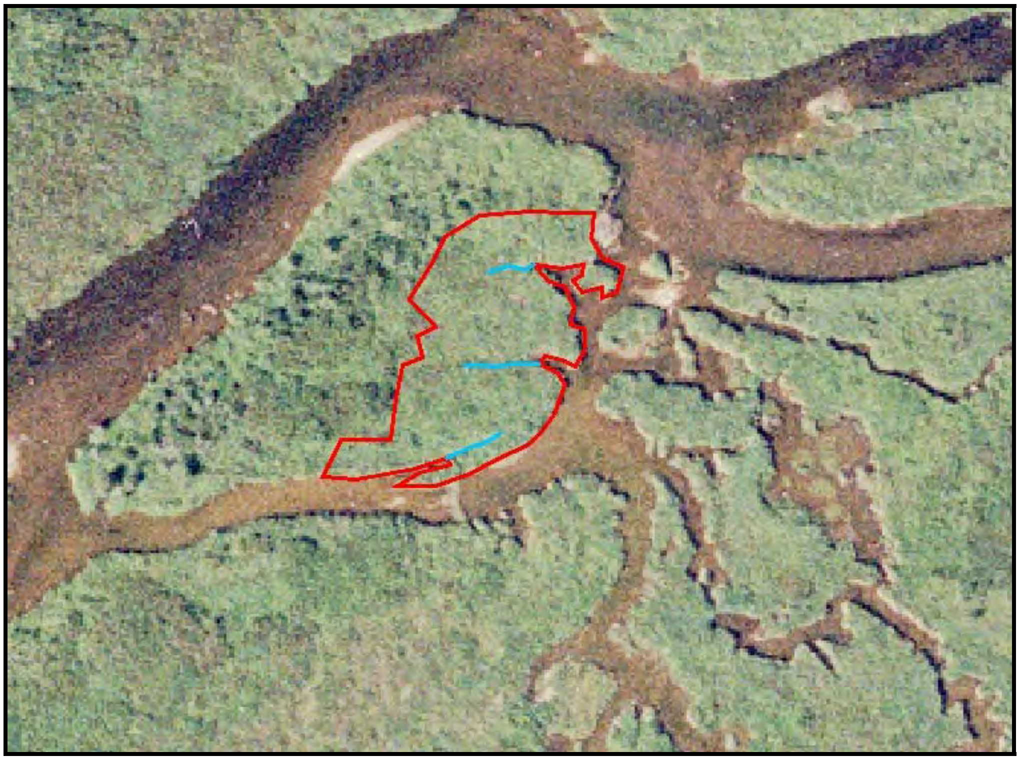


Figure 3. Riverine wetland is alternately flooded and drained by intermittent channels (blue). This map unit should be classified as **"Intermittent Inlet/Intermittent Outlet."**

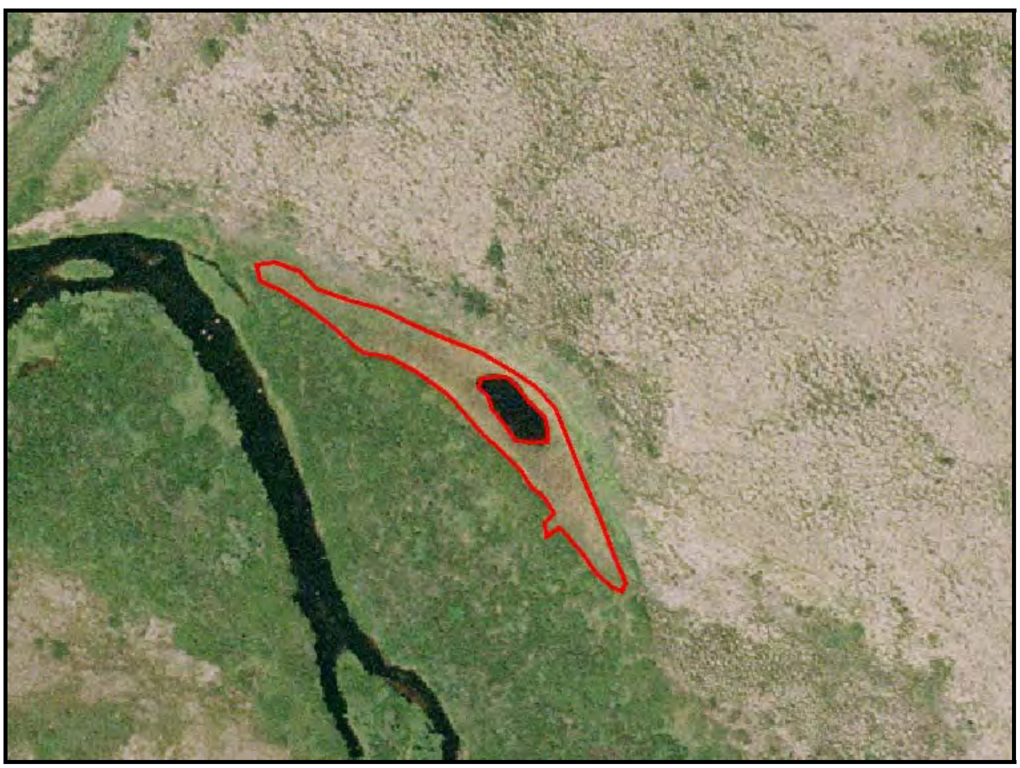


Figure 4. Slough in abandoned channel has no inlet or outlet Features.

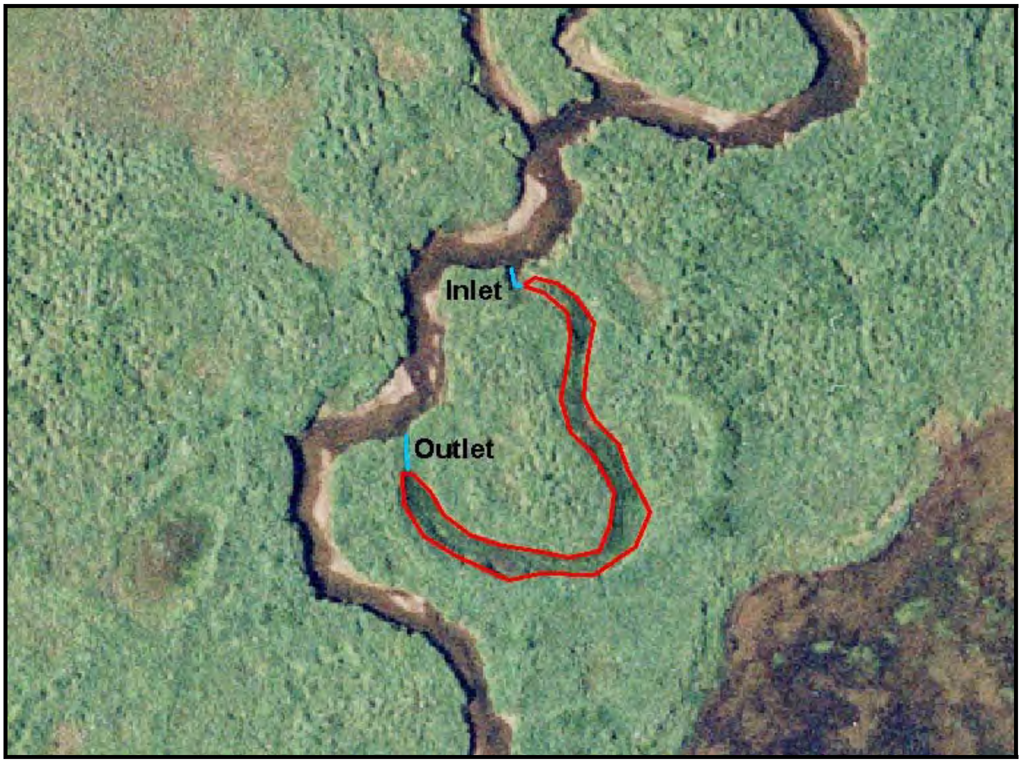


Figure 5. Oxbow feature that should be classified as **"Intermittent Inlet/Intermittent Outlet."**

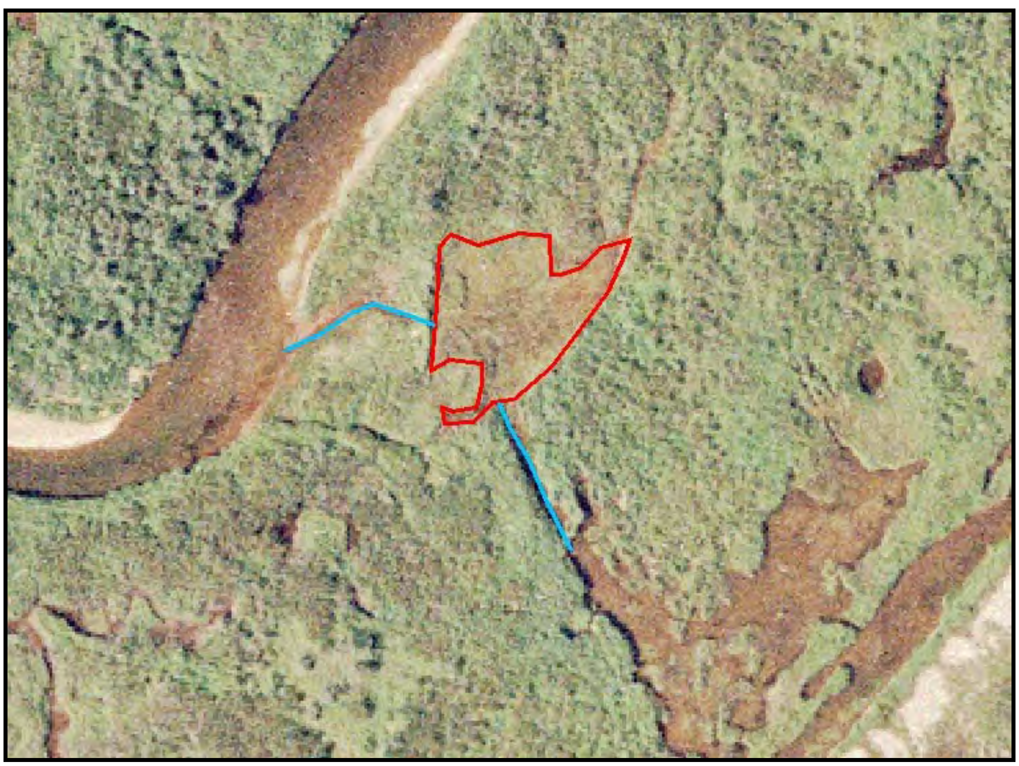


Figure 6. Floodplain marsh system classified as **"Perennial Inlet/Perennial Outlet."**

Slope

In general, the identification of inlets and outlets in slope wetlands is relatively straightforward (Figures 7 and 8). Probably the most difficult interpretation involves the presence of small inlets and/or outlets in very large slope complexes. Following delineation of the separate plant communities in these complexes, each map unit should be analyzed separately for the presence of inlets and outlets. In Figure 9, the delineated complex consists of 3 separate wetland map units. While the entire complex could be considered to have an inlet and outlet, separate analysis of the distinct communities results in the 3 different Inlet/Outlet classes: polygon A- **No Inlet/No Outlet**; polygon B – **Perennial Inlet/No Outlet**; and polygon C – **No Inlet/Perennial Outlet**.

Figure 7. Slope map unit with **"No Inlet/No Outlet"** classification.

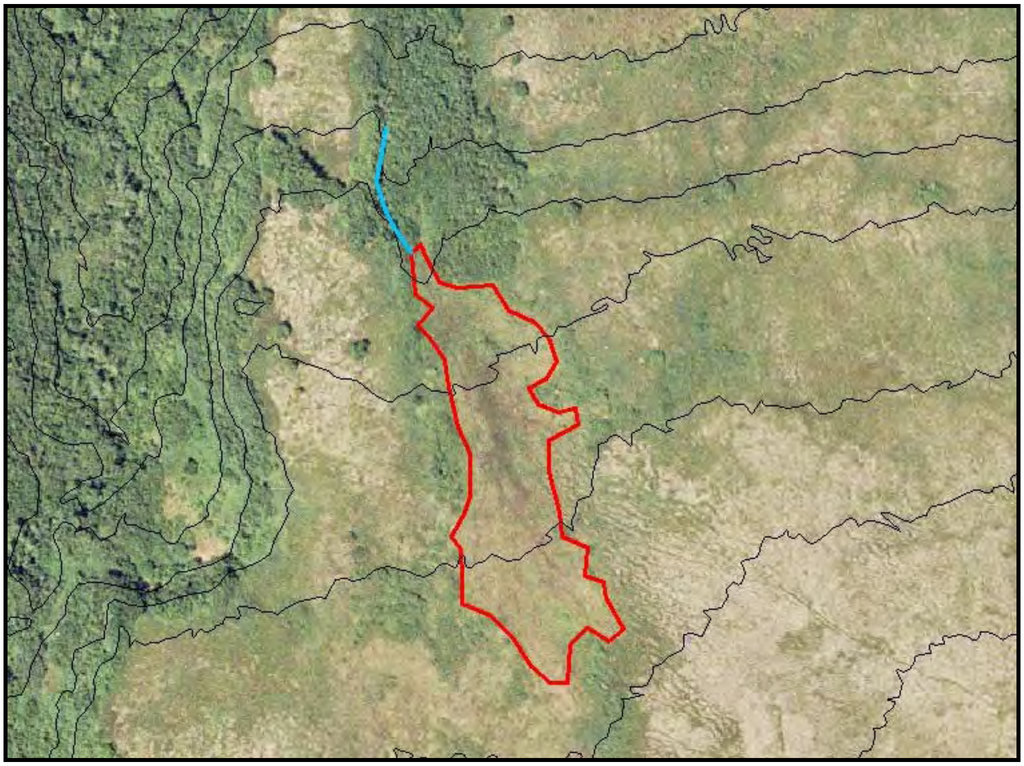


Figure 8. Slope map unit with **"No Inlet/Perrenial Outlet"** classification.

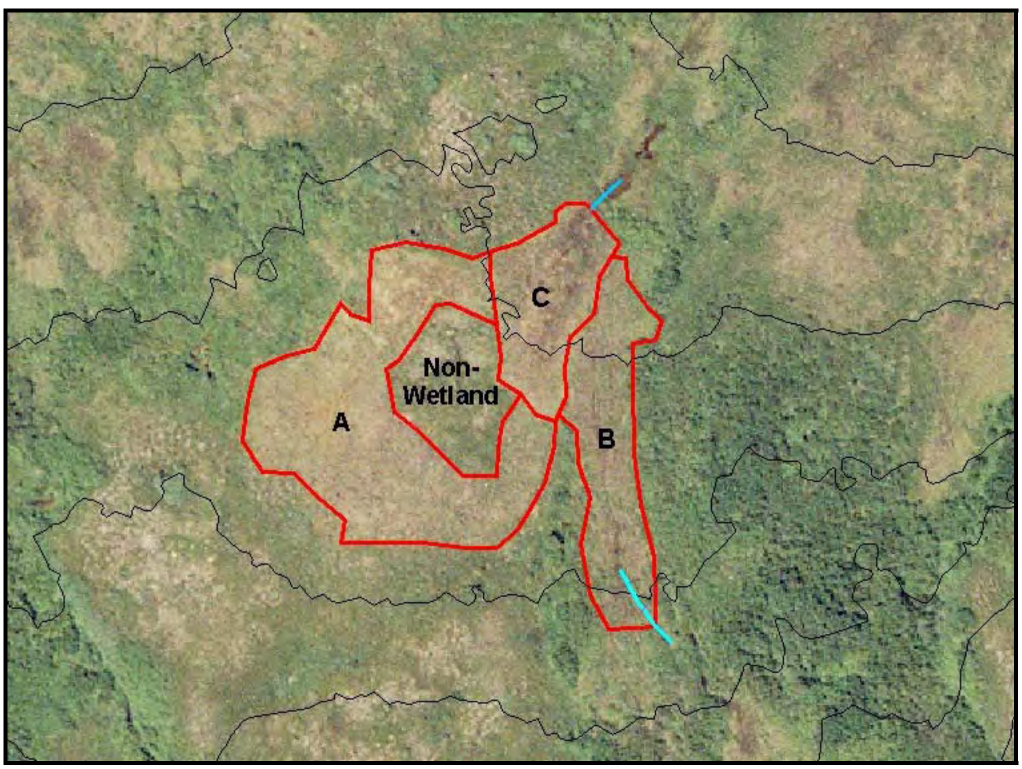


Figure 9. Slope complex with the following classifications:

A: **"No Inlet/No Outlet"**
B: **"Perennial Inlet/No Outlet"**
C: **"No Inlet/Perennial Outlet"**

Lacustrine Fringe

Although Lacustrine Fringe wetland map units are usually adjacent to open water, the "No Outlet" option applies unless there is an actual channel or very wet swale entering the lake. Figures 10 and 11 show typical Lacustrine Fringe map units with the most common inlet/outlet classification for this HGM class: **"No Inlet/No Outlet."**

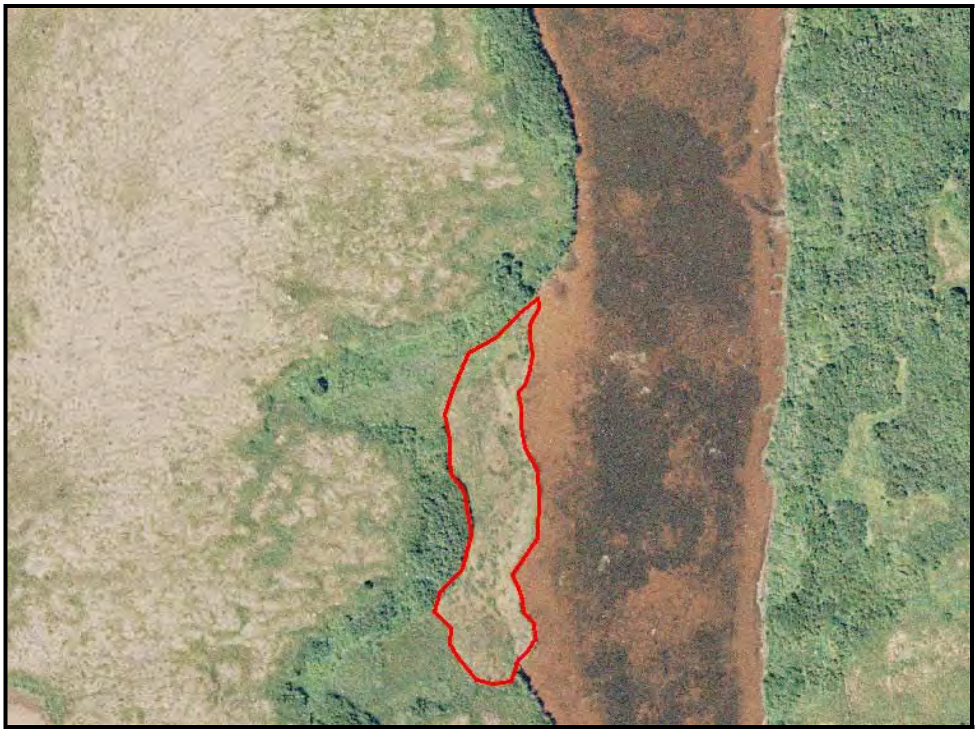


Figure 10. Lacustrine Fringe map unit with **"No Inlet/No Outlet"** classification.

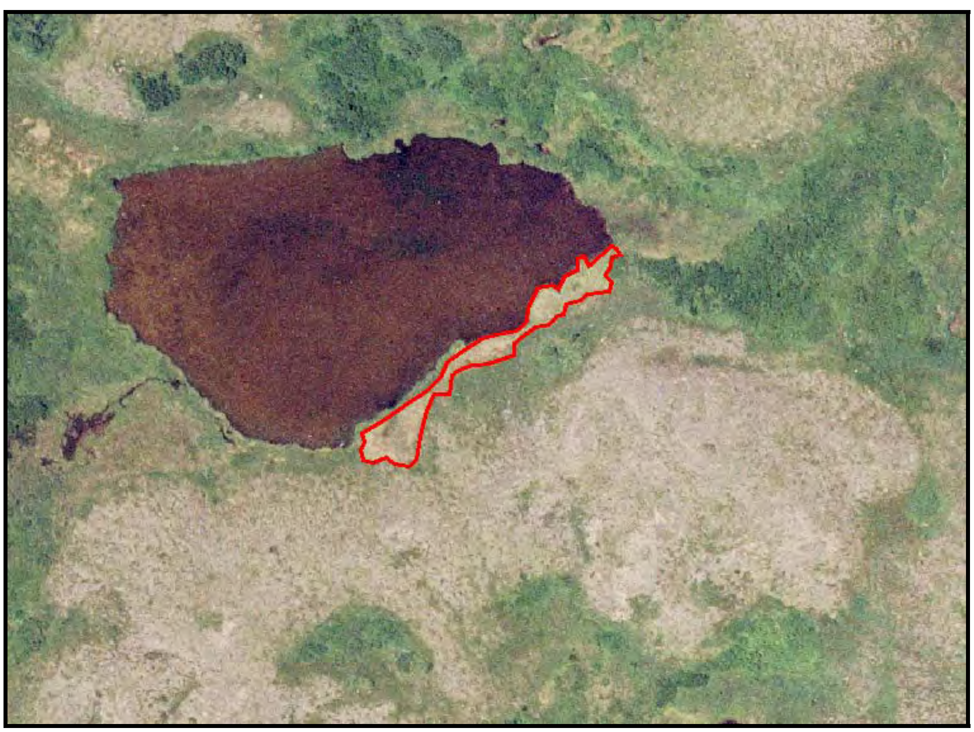


Figure 11. Lacustrine Fringe map unit with **"No Inlet/No Outlet"** classification.

Examples of Lacustrine Fringe wetlands with an inlet and/or outlet are illustrated in Figures 12 and 13.

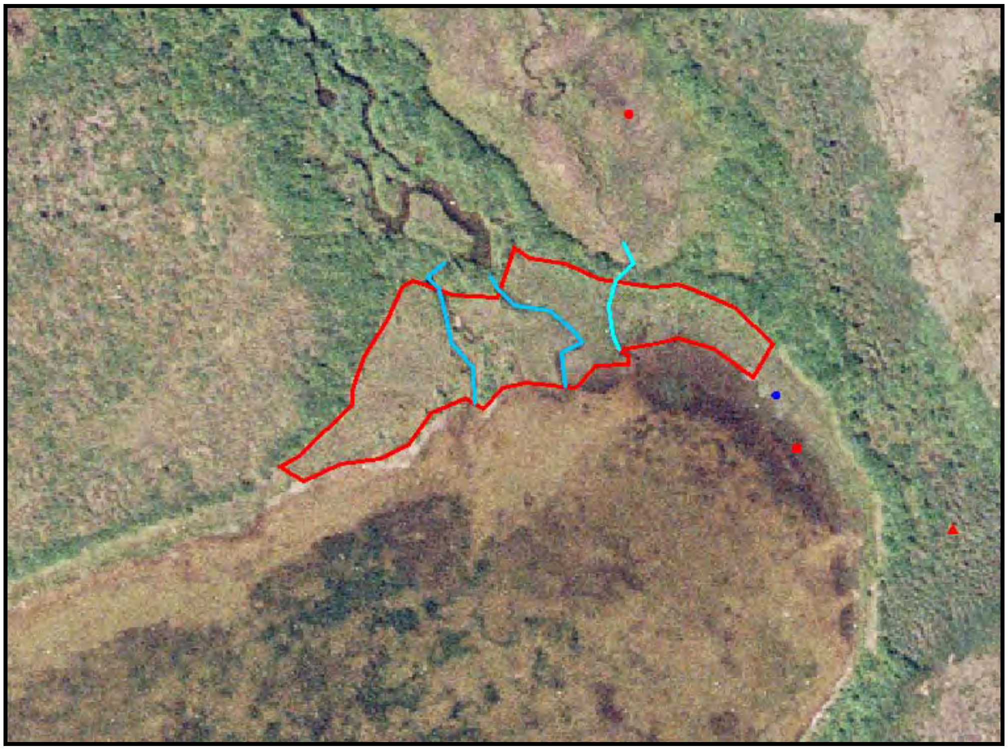


Figure 12. Lacustrine Fringe map unit classified as **"Perennial Inlet/Perennial Outlet."**

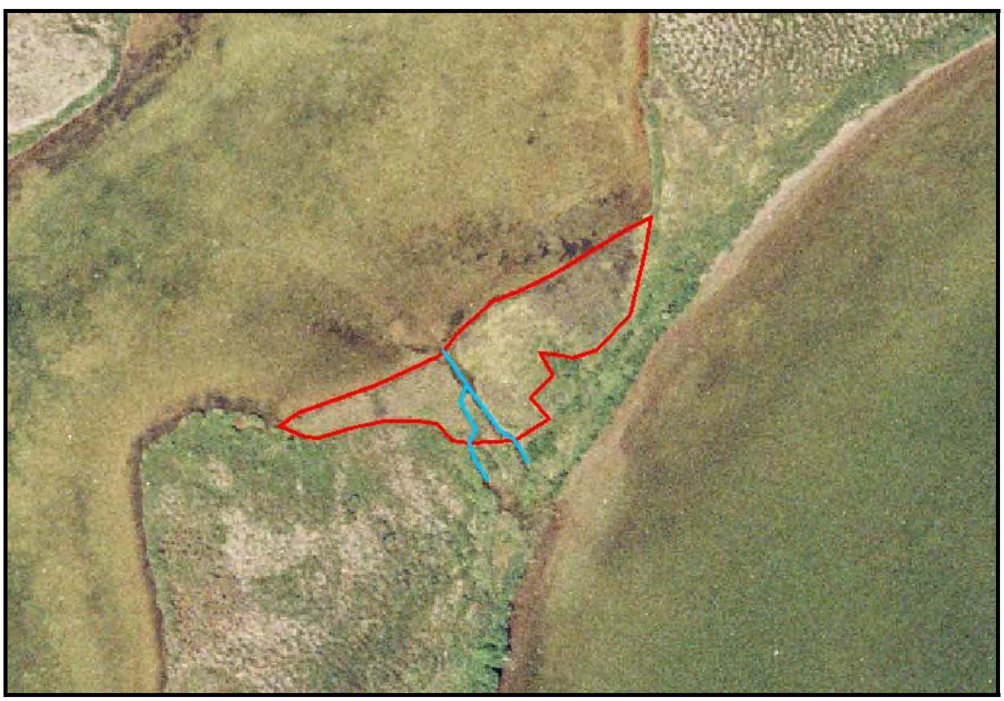


Figure 13. Lacustrine Fringe map unit classified as **"Perennial Inlet/Perennial Outlet."**

Regarding identification of Lacustrine Fringe wetlands, it needs to be emphasized that Slope class wetlands often occur at the edge of lakes. The hydrology of Lacustrine Fringe wetlands is maintained and influenced primarily by the lake water level. Through stereo viewing or inspection of the 2 ft. Lidar contour data, the analyst should be able to accurately separate the gently sloping Slope wetlands and true Lacustrine Fringe wetlands. Figure 14 shows a typical area where there are Slope and Lacustrine Fringe wetlands adjacent to a lake.

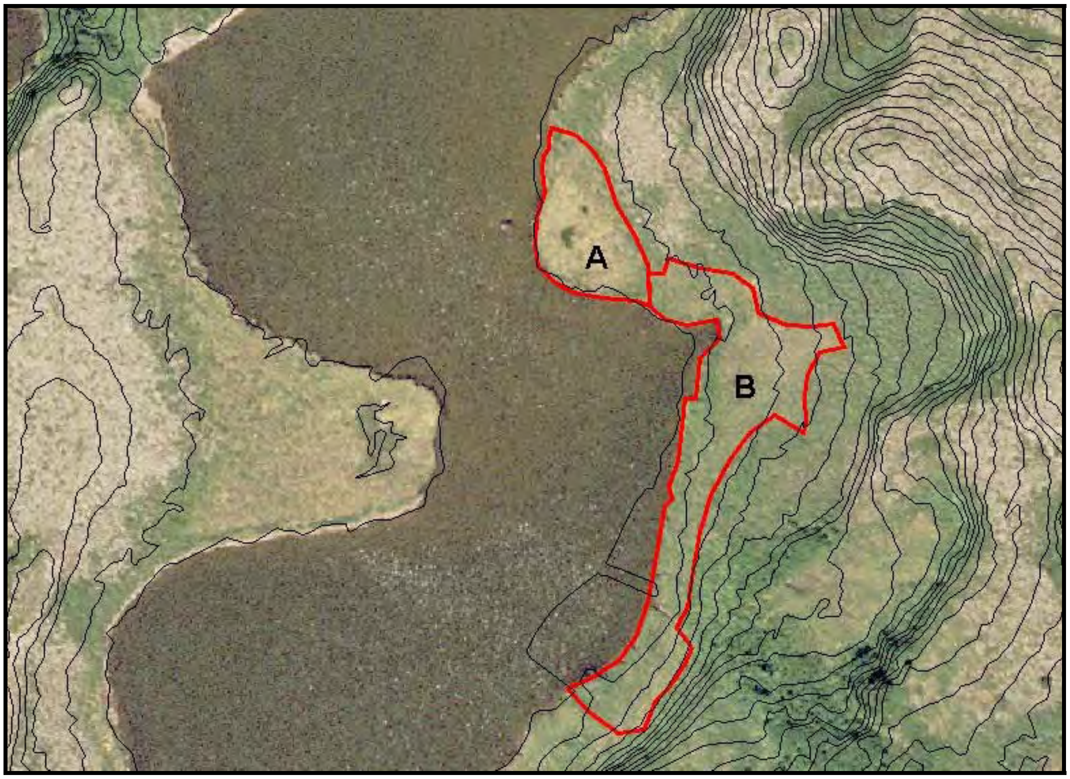


Figure 14. Map unit A is level along lake edge and is classified as Lacustrine Fringe. Map unit B slopes to edge of lake and is classified as a Slope wetland. The hydrology of this unit is maintained by seepage

Depressional

While vegetated Depressional wetlands are not very common in the project area, they can be found in a few areas. Most depressional wetlands lack an inlet and outlet. However, two examples of depressional wetlands classified as “Intermittent Inlet/No Outlet” are shown in Figures 15 and 16.

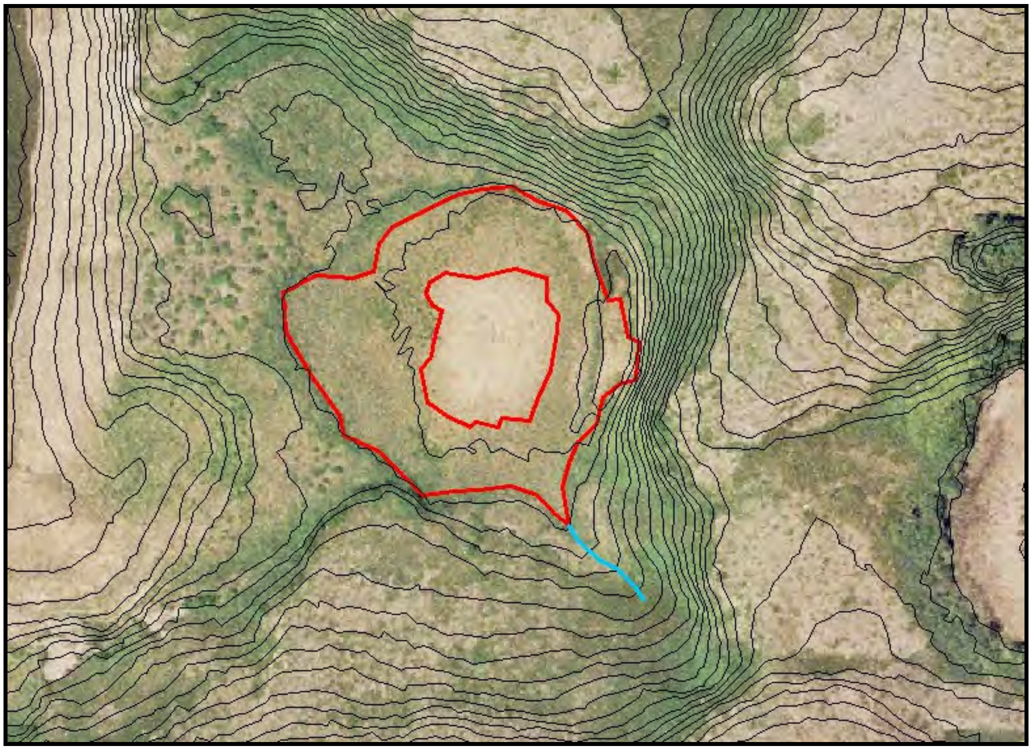


Figure 15. Depressional wetland classified as **"Intermittent Inlet/No Outlet"**

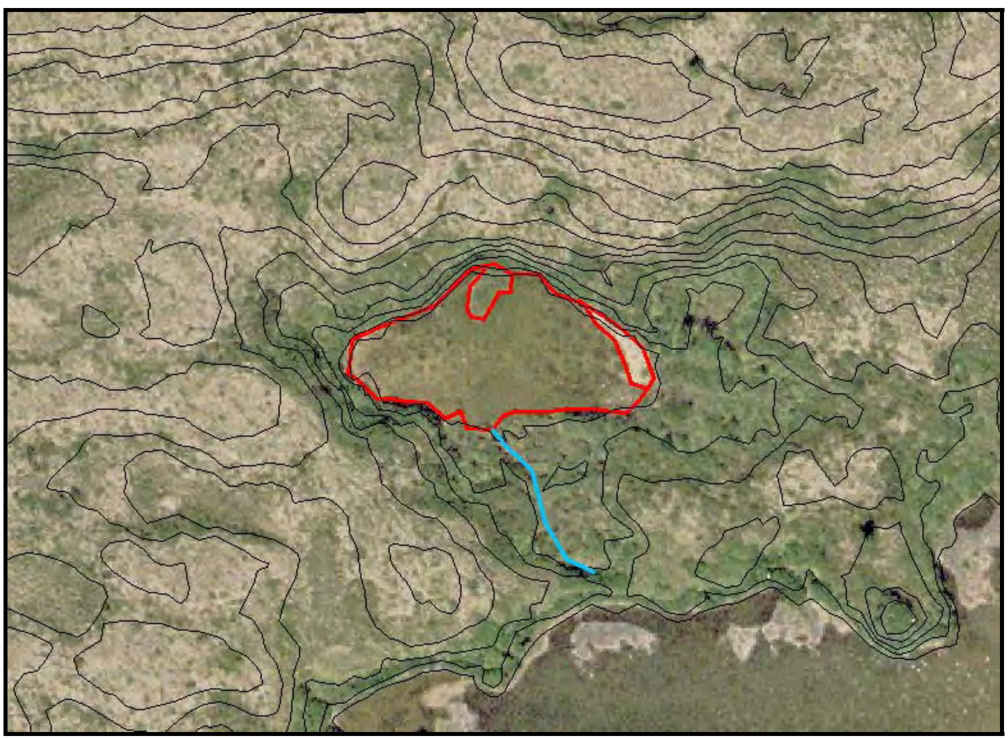


Figure 16. Depressional wetland classified as **"Intermittent Inlet/No Outlet"**

Appendix D-1

Wetland Inventory Data Form

WETLAND INVENTORY DATA

Project Number: ____________________ **Date:** ____________________

Wetland Number: ____________________

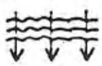
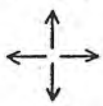
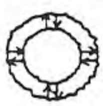
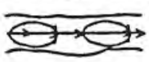
Aerial Photo Numbers: ____________________

USGS Quadrangle: ____________________

Field Investigators: ____________________

PART 1 - CHARACTERIZATION of WETLAND

SURFACE WATER FLOW VECTORS

Condition	Percent/Acreage	
	______	Depressional
	______	Slope
	______	Flat
	______	Extensive Peatland
	______	Lacustrine Fringe
	______	Riverine

VEGETATION TYPES

Type	Percent/Acreage
Forested Wetland	
Evergreen	
Needle-leaved	______
Deciduous	
Broad-leaved	______
Needle-leaved	______
Scrub Shrub	
Evergreen	
Broad-leaved	______
Needle-leaved	______
Deciduous	
Broad-leaved	______
Needle-leaved	______
Emergent Wetland	
Persistent	______
Non-persistent	______
Aquatic Bed	______
Total	______

SOIL TYPES

Histosol
- Fibric ☐
- Hemic ☐
- Sapric ☐

Mineral Hydric Soil
- Gravelly ☐
- Sandy ☐
- Silty ☐
- Clayey ☐

GEOLOGY

Surficial:

Bedrock:

Comments: ____________________

____

____

____

____

PLANT SPECIES

	OW	FW	F	FU	OU	DOM	COM	OCC	C	S	TS	LS	H
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

OW	Obligate Wetland	COM	Common
FW	Facultative Wetland	OCC	Occasional
F	Facultative	C	Canopy
FU	Facultative Upland	S	Sapling
OU	Obligate Upland	TS	Tall Shrub
DOM	Dominant	LS	Low Shrub
		H	Herb

PRE-EMPTIVE STATUS

______ Public ownership

______ Wildlife management area

______ Fisheries management area

______ Designated State or Federal protected wetland

______ Documented habitat for state or federal listed species

______ Regionally scarce wetland category

______ Historic/archaeologic area

WETLAND INVENTORY DATA (continued)

PART 2 - CHARACTERIZATION of MODEL VARIABLES

LANDSCAPE VARIABLES

Size:
- ☐ Small (<10 acres)
- ☐ Medium (10-100 acres)
- ☐ Large (>100 acres)

Wetland Juxtaposition:
- ☐ Connected Upstream and Downstream
- ☐ Only Connected Above
- ☐ Only Connected Below
- ☐ Other Wetlands Nearby but not Connected
- ☐ Wetland Isolated

Fire Occurence and Frequency:
- ☐ Natural; Predictable Frequency
- ☐ Natural; Sporadic Frequency
- ☐ Human-caused; Predictable
- ☐ Human-caused; Sporadic
- ☐ Rare Event
- ☐ No Evidence

Regional Scarcity:
- ☐ Not Scarce (>5% of total wetland area of region)
- ☐ Scarce (<5% of total wetland area of region)

Watershed Land Use:
- ☐ > 50% urbanized
- ☐ 25-50% urbanized
- ☐ 0-25% urbanized

HYDROLOGIC VARIABLES

Surface Water Level Fluctuation of Wetland:
- ☐ High Fluctuation
- ☐ Low Fluctuation
- ☐ Never Inundated

Frequency of Overbank Flooding:
- ☐ Return Interval > 5 yrs.
- ☐ Return Interval 2-5 yrs.
- ☐ Return Interval 1-2 yrs.
- ☐ No Overbank Flooding

pH:
- ☐ Acid <5.5
- ☐ Circumneutral 5.5-7.4
- ☐ Alkaline >7.4
- ☐ No Water

Surficial Geologic Deposit Under Wetland
- ☐ Low Permeability Stratified Deposits
- ☐ High Permeability Stratified Deposits
- ☐ Glacial Till

Wetland Land Use:
- ☐ High Intensity (ie. agriculture)
- ☐ Moderate Intensity (ie. forestry)
- ☐ Low Intensity (ie. open space)

Wetland Water Regime:
- ☐ Wet: Perm Flooded, Intermittently Exposed, Semiperm. Flooded
- ☐ Drier: Seasonally Flooded, Temporarily Flooded, Saturated

Basin Topographic Gradient:
- ☐ High Gradient >2%
- ☐ Low Gradient <2%

Degree of Outlet Restriction:
- ☐ Restricted Outflow
- ☐ Unrestricted Outflow
- ☐ No Outflow

Ratio of Wetland Area to Watershed Area:
- ☐ High >10%
- ☐ Low <10%

Microrelief of Wetland Surface:
- ☐ Pronounced >45 cm
- ☐ Well Developed 15-45 cm
- ☐ Poorly Developed <15 cm
- ☐ Absent

Inlet/Outlet Class:
- ☐ No Inlet/No Outlet
- ☐ No Inlet/Intermittent Outlet
- ☐ No Inlet/Perennial Outlet
- ☐ Intermittent Inlet/No Outlet
- ☐ Intermittent Inlet/Intermittent Outlet
- ☐ Intermittent Outlet/Perennial Outlet
- ☐ Perennial Inlet/No Outlet
- ☐ Perennial Inlet/ Intermittent Outlet
- ☐ Perennial Inlet/Perennial Outlet

Nested Piezometer Data:
- ☐ Recharge
- ☐ Discharge
- ☐ Horizontal Flow
- ☐ Not Available

Relationship of Wetlands' Substrate Elevation to Regional Piezometric Surface:
- ☐ Piez. Surface Above or at Substrate elev.
- ☐ Piez. Surface below Substrate elev.
- ☐ Not Available

Evidence of Sedimentation:
- ☐ No Evidence Observed
- ☐ Sediment Observed on Wetland Substrate
- ☐ Fluvaquent Soils

Evidence of Seeps and Springs:
- ☐ No Seeps or Springs
- ☐ Seeps Observed
- ☐ Perennial Spring
- ☐ Intermittent Spring

SOIL VARIABLES

Soil Lacking:
- ☐

Histosol:
- ☐ Fibric
- ☐ Hemic
- ☐ Sapric

Mineral Hydric Soil:
- ☐ Gravelly
- ☐ Sandy
- ☐ Silty
- ☐ Clayey

VEGETATION VARIABLES

Vegetation Lacking:
- ☐

Dominant Wetland Type:
- ☐ Forested - Evergreen - Needle-leaved
- ☐ Forested - Deciduous - Broad-leaved
- ☐ Forested - Deciduous - Needle-leaved
- ☐ Scrub Shrub - Evergreen - Broad-leaved
- ☐ Scrub Shrub - Evergreen - Needle-leaved
- ☐ Scrub Shrub - Deciduous - Broad-leaved
- ☐ Scrub Shrub - Deciduous - Needle-leaved
- ☐ Emergent - Persistent
- ☐ Emergent - Non-persistent
- ☐ Aquatic Bed

Number of Types & Relative Proportions:

Number of Types	Evenness of Distribution
☐ Actual #	☐ Even Distribution
☐ 5	☐ Moderately Even Distribution
☐ 4	☐ Highly Uneven Distribution
☐ 3	
☐ 2	
☐ 1	

Vegetation Density/Dominance:
- ☐ Sparse (0-20%)
- ☐ Low Density (20-40%)
- ☐ Medium Density (40-60%)
- ☐ High Density (60-80%)
- ☐ Very High Density (80-100%)

Vegetative Interspersion:
- ☐ High (small groupings, diverse and interspersed)
- ☐ Moderate (broken irregular rings)
- ☐ Low (large patches, concentric rings)

Number of Layers and Percent Cover:

Number of Layers	% Cover
☐ 6 or > (actual #)	1. submergents:
☐ 5	2. floating:
☐ 4	3. moss-lichen:
☐ 3	4. short herb:
☐ 2	5. tall herb:
☐ 1	6. dwarf shrub:
	7. short shrub:
	8. tall shrub:
	9. sapling:
	10. tree:

Plant Species Diversity:
- ☐ Low 1-2 plots sampled
- ☐ Medium 3-4 plots sampled
- ☐ High 5 or more plots sampled

Proportion of Animal Food Plants:
- ☐ Low (5-25% cover)
- ☐ Medium (25-50% cover)
- ☐ High (>50% cover)

Cover Distribution:
- ☐ Continuous Cover
- ☐ Small Scattered Patches
- ☐ 1 or More Large Patches; Parts of Site Open
- ☐ Solitary, Scattered Stems

Dead Woody Material:
- ☐ Abrundant (>50 of wetland surface)
- ☐ Moderately Abrundant (25-50% of surface)
- ☐ Low Abrundance (0-25% of surface)

Interspersion of Cover and Open Water:
- ☐ 26-75% Scattered or Peripheral
- ☐ >75% Scattered or Peripheral
- ☐ <25% Scattered or Peripheral
- ☐ 100% Cover or Open Water

Stream Sinuosity:
- ☐ Highly Convoluted (index 1.50 or >)
- ☐ Moderately Convoluted (index 1.25-1.50)
- ☐ Straight/Slightly Irreg. (index) 1.10-1.25

Presence of Islands:
- ☐ Several to Many
- ☐ One or Few
- ☐ Absent

Appendix D-2

JD Data Form

GPS Lat:
GPS Long:
GPS Elev:
GPS Datum: NAD83

Data Form
Routine Wetland Determination
&
Rapid Procedure for Assessing Wetland Functional Capacity

Plot No: 3PP________
Wetland Status: __________
(Per 1987 Manual; Y, Y-T, N-T, N)

Project/Site: Donlin Gold	**Date:** _________/__________/_______
Applicant/Owner: Donlin Gold LLC	**County:**
Investigator: 1) ____________2)____________ 3)___________	**State:** Alaska
Do Normal Circumstances Exist on the Site? YES NO	**Watershed:** ___________________________
Is the Site Significantly Disturbed (Atypical) YES NO	**Field Paper Plot/Tile No: T**________________
Vegetation______ Soil _____ Hydrology ______	**Ortho No:** _________ ***Air Photo No:*** _________
Is the Area a Potential Problem Area (87 Manual)? YES NO	**Township:** _________ **Range:** ____________
Vegetation _____ Soil _____ or Hydrology _____	**Section:** _________ **Quad No.:** ___________
Distance to Nearest Disturbance (ft) ________________________	***General*** ________________________________
Type of Disturbance (if any)	***Location:*** ________________________________

Vegetation

T=Trace, <3 Percent. P=Present in polygon but not plot. E:=On edge of plot and noteworthy. 1/10-acre circular plot if site conditions allow.

Species	87 Strat	Ind. Stat	% ABS Cov	Tree Ht (ft)	DBH (in)	Species	87 Strat	Ind Stat	% ABS Cov	Additional Species
1.						9.				
2.						10.				
3.						11.				
4.						12.				
5.						13.				
6.						14.				
7.						15.				
8.						16.				
Percent of Dominant Species that are OBL, FACW, or FAC (Excluding FAC-): __________% > 50% -- 87 Criteria Met * = Dominant Species	**Hydrophytic Vegetation 1987 Present?** Y N N(50)		**Database Calculated PI** ________ **Hydrophytic?** Y N			17.				
						18.				
						19.				
						20.				
						21.				

Vegetation Comments:

____

% By Stratum (Magee – Wetlands Only –Database Calculated)
Canopy (Tree) ____ SAP = Sapling ____ TS = Tall Shrub ____ SUB = Submerged ___
SS = Short Shrub ____ DS = Dwarf Shrub ____ TH = Tall Herb ____ No. Species ________
SH= Short Herb ____ ML = Moss-Lichen _____ F = Floating ____ No. Layers ________

Final Project Vegetation Type :

____
Field Veg Type: ______________________
Field JDWet_Code: ____________________
Cowardin Hydrologic Regime: ______________
Method: 50/20 Stratum. All Species ≥20% Dominant

Hydrology

_X___ **Recorded Data (Describe in Remarks):**
_______ Stream, Lake, or Tide Gauge
___X___ Aerial Photographs (2009, 2010, ______)
_______Other

If Water Present:
Waterbody Type: ___________________________ pH: ___________ EC: ___________
pH Meter #: ______ EC Meter #: _____
Stream Width: ______(ft) Stream Gradient: _____(%)
If Meters Available:
DO: _______ *BP:* ______ *Temp:* ____*(C)*
DO Meter #: _________

Field Observations (inches):
Surface Water Present? (Y/N) ______ Depth of Surface Water: ___________
Water Table Present? (Y/N) ______ Depth to Water Table: ___________
Impeding Layer? (Y/N) ______ Depth to Impeding Layer ___________
Impeding Layer Type __________________ Lateral Flow @ ___________
Saturated Soil Present? (Y/N) ______ Depth to Saturated Soil ___________
Episaturation ___ Endosaturation ___

1987 Wetland Hydrology Indicators:
Primary Indicators:
_______ Inundated
_______ Saturated in Upper 12 Inches
_______ Water Marks
_______ Drift Lines
_______ Sediment Deposits
_______ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
_______ Oxidized Root Channels in Upper 12"
_______ Water-Stained Leaves
_______ Local Soil Survey Data
_______ FAC- Neutral Test
_______ Other (List AK Manual Codes Below)
AK Manual Codes:

Hydrology Comments 87 Manual:

Aspect (Degrees): _________(Direction)___________
Percent Slope: _______% Elevation (ft): ___________
Landform: ______________________________
Macro-topography:__________________________
Micro-topography:__________________________
HGM Class: _____________________________

Wetland Hydrology Present?
1987 Manual
Yes No Marginal

PLOT NO: 3PP__________

Soils

Soil Survey Map Unit Name: ____________________ (Series and Phase): ____________________
Field Drainage Class: ________ (from NASIS)
Field Taxonomy (Subgroup): ____________________
10th *Edition of Keys Used*

Soil Profile Description: Colors Moist Unless Otherwise Noted

Depth (Inches)	Horizon Name	Matrix Color (s)	Matrix (%)	Feature Type	Feature (%)	Feature Loc	Mottles & Other Features Color	Abundance	Size	Contrast	Matrix Texture	Matrix Structure	Roots	C. Frags Type - %	pH	HC#

Horizon Comments (HC#)
1. FE+ = N
2. FE+ = Y
3.
4.
5.
6.
7.
8.

COE 1987 Manual Hydric Soil Indicators

_______ Histosol (Sat, 16+")
_______ Histic Epipedon (Sat, 8-16")
_______ Sulfidic Odor ____ Depth (in)
_______ AMR & Reducing Conditions
Per Alpha-Alpha ___ Meter ___ H2S ___
Redox Meter #: ________

________ Gleyed or Low-Chroma Colors
________ High Organic Content Surface Layer Sandy Soils
________ Organic Streaking in Sandy Soils
________ Listed on Local / National Hydric Soils List
________ Other (List codes below - used with 1 or more- 87 indicators)
________ **Hydric Per 1987 COE Manual?**

Other Soil Observations:
Depth of Organic Mat ________ (inches)
Depth to Permafrost ________ (inches)
Major Rooting Zone ________ (inches)
Soil Temperature (20" Below Surface) _______ (F)
Cryoturbated Yes No Slight (Circle one)
Thixotropic Yes No Slight (Circle one)

HC # Explanations: FE+ Y = Positive Reaction to Alpha Alpha, N = Negative Reaction – No Vial Test, D = Delayed Spray Test – No Vial Test
FE+ *PLC = Negative Reaction Spray Test & Positive Vial Test for Low Chroma Soil (with Salt)*

NTCHS Criteria (See Page 3)
AK ______(year) ______ ______ ______ ______ (Indicator Codes)
AK 2007 (year) ______ ______ ______ ______ (Indicator Codes)

Profile Comments: ____________________

Wetland Determination

	1987	AK 2007 Manual
Hydrophytic Vegetation Present?	Yes No No (50)	Yes No
Wetland Hydrology Present?	Yes No Marginal	Yes No
Hydric Soils Present?	Yes No Marginal	Yes No Unsure

Plot Meet 1987 Criteria? Yes Yes–Transitional No No-Transitional
Plot Meet AK Manual Criteria? Yes Yes–Transitional No No-Transitional

Remarks:

Plot Photographs Are: **Kodak Field Imaging** ______ **IKE No.** ______ **Other: Digital Frame or JPEGs** ____________ **Disposable**
Site Marked on Map? ______ **Site Flagged?** __________

Wildlife Observations:

Engineering Concerns:

PLOT NO: 3PP__________

AK MANUAL HYDROLOGY SECTION
(Used As Reference List for Other Indicators)

Primary Indicators		Secondary Indicators	
Yes No	Surface Water (A1)	Yes No	Water-Stained Leaves (B9)
Yes No	High Water Table (A2)	Yes No	Drainage Patterns (B10)
Yes No	Saturation (A3)	Yes No	Oxidized Rhizospheres on Living Roots (C3)
Yes No	Water Marks (B1)	Yes No	Presence of Reduced Iron (C4)
Yes No	Sediment Deposits (B2)	Yes No	Salt Deposits (C5)
Yes No	Drift Deposits (B3)	Yes No	Stunted or Stressed Plants (D1)
Yes No	Mat or Crust of Algae (B4)	Yes No	Geomorphic Position (D2)
Yes No	Marl Deposits (B15)		
Yes No	Iron Deposits (B5)	Yes No	Shallow Aquitard (D3)
Yes No	Surface Soil Cracks (B6)	Yes No	Micro-topographic Relief (D4)
Yes No	Inundation Visible on Aerial Imagery (B7)	Yes No	FAC-Neutral Test (D5)
Yes No	Sparsely Vegetated Concave Surface (B8)	Yes No	Are climatic/hydrologic conditions at the site typical for this time of year (If no or unknown explain below)?
Yes No	Hydrogen Sulfide Odor (C1)		
Yes No	Dry-Season Water Table (C2) to Late July *Water Table Within 24" Mineral Soil* *Water Table Within 40" Organic Soil*	*Comments:*	
Yes No	Other (Describe):	***Plot Has One Primary or Two Secondary Indicators?*** **Yes No If Yes, Plot Meets AK Manual Hydrology**	

AK MANUAL SOILS SECTION
(List Indicator Codes on NTCHS Section on Page 2)

Primary Indicator Present?	Primary Indicator Code	Primary Indicator Description	Comments
Yes No Unsure	A1	Histosol or Histel	Must be saturated except during dry season
Yes No Unsure	A2	Histic Epipedon	
Yes No Unsure	A4	Hydrogen Sulfide	Within 12" of Mineral Surface
Yes No Unsure	A12	Thick Dark Surface	
Yes No Unsure	A13	Alaska Gleyed	Within 12" of Mineral Surface
Yes No Unsure	A14	Alaska Redox	Within 12" of Mineral Surface
Yes No Unsure	A15	Alaska Gleyed Pores	Within 12" of Mineral Surface
Indicators for Problematic Hydric Soils	**Indicator Code**	**Indicator Description**	These Indicators Require One Indicator of Hydrophytic Vegetation and One Primary Indicator of Wetland Hydrology
Yes No Unsure	TA4	Alaska Color Change	
Yes No Unsure	TA5	Alaska Alpine Swales	
Yes No Unsure	*4a3*	Alaska Redox with 2.5Y Hue	
Yes No Unsure	*4a4*	Alaska Gleyed Without Hue 5Y or Redder Underlying Layer	
Other Considerations (Not NTCHS Indicators!)			
Yes No Unsure	*4c*	Positive AA Test	These Indicators Require One Indicator of Hydrophytic Vegetation and One Primary Indicator of Wetland Hydrology and may have specific landscape requirements.
Yes No Unsure	*4d*	Ponded Flooded H2O Table	
Yes No Unsure	*4b1*	Soils with Low Organic Carbon Present?	
Yes No Unsure	*4b2*	Soils with Low Weatherable Iron Content?	
Yes No Unsure	*4b3*	Soils pH greater than 7.2?	
Yes No Unsure	*4b4*	Recently Developed Wetland?	

Codes in italics are <u>not recognized</u> NTCHS indicators in Alaska at this time.

MISC. FACTORS

Answer based on personal knowledge of the area. This will ultimately be updated through the GIS.

☐ Public Ownership ☐ Private
☐ Wildlife Management Area
☐ Fisheries Management Area
☐ Historic/Archaeological Area
☐ Designated Protected Wetland
☐ Documented Habitat for Listed Species
☐ Regionally Scarce (< 5%) Wetland
☐ Recreational Use Area
☐ Subsistence Use Area %Cov =

LANDSCAPE VARIABLES

Estimate. GIS will update from digital mapping.

Size: ~ _____ (acres) _______(GIS)
☐ Small (<10 ac)
☐ Med. (10 -100 ac)
☐ Large (>100 ac)

Ratio of This Wetland Area to Total Watershed Area (GIS)_____ %
Estimate: Final will be calculated by GIS.
☐ High (>10%) ☐ Low (≤10%)

Wetland/Water Juxtaposition
A wetland or Water of the US directly abutting subject polygon upslope or down slope, including intermittent streams, constitutes a connection.
☐ Connected up & downstream
☐ Only connected above
☐ Only connected below
☐ Other wetlands nearby-not connected
☐ Wetland isolated

Watershed Land Use-% Urbanized

☐>50% ☐>25-50% ☐ 0-25%

Wetland Land Use Intensity

☐ High (agricult) ☐ Moderate (forestry)
☐ Low (open space)

SOIL VARIABLES

Based on dominant texture in upper 16" if mineral. If sandy loam, it's sandy. If finer (e.g., loam), it's silty (no clays!). If Histic Epipedon, Select 2.

☐ Soil lacking
☐ Fibric ☐ Gravelly
☐ Hemic ☐ Sandy
☐ Sapric ☐ Silty

Surficial Geology Type: *From GIS*

HYDROLOGIC VARIABLES

Surficial Deposit Under Wetland
GIS Data Take Precedence Where Available
☐ Low permeability stratified
☐ High permeability stratified
☐ Glacial till Compact? ☐

Micro-Relief of Wetland Surface
= Microtopography on pg 1 of form
☐ Pronounced >45 cm (>17.7 ")
☐ Well developed 15-45 cm (5.9-17.7")
☐ Poorly developed <15cm (<5.9 ")
☐ Absent

Wetland Water Regime (Cowardin)
Non-Tidal: ☐ A ☐ B ☐ C ☐ F ☐ H
Tidal: ☐ P ☐ N ☐ L
Fresh Tidal: ☐ S ☐ R ☐ T ☐N

Surface Water Level Fluctuation
Counts only the depth above ground surface.
☐ High (≥8") ☐ Low <8")
☐ None (no surface water in summer)

Overbank Flooding Frequency
Return interval: Estimate based on presence of a stream or lake.
☐ > 5 yrs ☐ >2-5 yrs ☐ 1-2 yrs
☐ No overbank flooding (or stream/lake)

Evidence of Recent Sedimentation (transported by H20)
☐ No evidence
☐ Fluvaquent soil (or other ind'g deposits)
☐ Sediment observed on substrate

Basin Topographic Gradient
Same as slope of polygon.
☐ High (>2%) ☐ Low (≤2%)

Degree of Outlet Restriction
☐ Restricted (road/culverts, dam, log jams)
☐ Unrestricted outflow
☐ No outflow

Inlet/Outlet Class (polygon)
Inlet or outlet is a channel or very wet swale with surface water at some time. This does not include diffuse overland/through-soil flow. A seep does not constitute an inlet.

Inlet	**Outlet**
☐ None	☐ None
☐ Intermittent	☐ Intermittent
☐ Perennial	☐ Perennial

Water pH = ______ Measured using a meter in standing water within the polygon; or where absent -- in the soil pit-or not measured.
☐ No water
☐ Acid <5.5
☐ Circum-neutral 5.5-7.4
☐ Alkaline >7.4

Nested Piezometer Data
☐Not available (Field) – Possible GIS Update

Wetland's Substrate Elev. to Regional Piezometric Surface
☐ Not available (Field) – Possible GIS Update

Evidence of Seeps & Springs
Observation or evidence of seep or spring, or even mild evidence of seep or spring (e.g., toe of slope that abruptly becomes wet)
☐ No seeps or springs
☐ Seeps (Mapped? Yes or No - *GIS*)
☐ Perennial spring
☐ Intermittent spring

Fish Present? ☐ ____________

PLOT NO: 3PP__________

VEGETATION VARIABLES

Primary Vegetation Types
Check >1 if inclusions of >1 dominant (canopy) form. If >1, include % of its cover of the polygon. Entire polygon must be one HGM class.
☐ Vegetation lacking
☐ Forest, evergreen, needle-lvd%_____
☐ Forest, deciduous, broad-lvd%_____
☐ Forest, deciduous, needle-lvd%____
☐ Scrb/shrb, evergrn, broad-lvd%_____
☐ Scrb/shrb, evergrn, needle-lvd%____
☐ Scrb/shrb, decid,.broad-lvd %______
☐ Scrb/shrb, decid, needle-lvd%______
Emergents:
☐ Persistent %____ ☐Non-persis%___
☐ Aquatic bed %____ ☐ Moss% _____
☐ Herbaceous %____ ☐ Lichen% _____

Number of Veg. Types __ (chkd above)
Based on % cover of types checked above.
☐ Even distribution
(1 type =100%, 2 types = 45-55%, 3 types=30-35)
☐ Moderately even (30-44%, 56-70%)
☐ Highly uneven distribution (0-29,71-100)

Veg. Density/Dominance
100% minus bare ground or unvegetated water
☐ Sparse (0-20%)
☐ Low density (>20-40%)
☐ Medium density (>40-60%)
☐ High density (>60-80%)
☐ Very high density (>80-100%)

Vegetative Interspersion (within plot)
☐ High (small groups, well intrsp'd, lots of edge)
☐ Moderate (broken irregular rings, mod edge)
☐ Low (Lrg patches, concentric rings, low edge)

Plant Species Diversity
☐ Low (0-9 vascular species)
☐ Medium (10-18 vascular species)
☐ High (>18 vascular species)

Cover of Animal Food Plants
Estimate – Final Determined in GIS.
☐Low (5-25%) ☐Med (>25-50%) ☐ Hi (>50%)

Cover Distribution (based on vole)
☐ Continuous cover (of veg)
☐ Small scattered patches (of veg)
☐ 1 or more large patches, part open
☐ Solitary scattered stems (of veg)

Interspersion Cover/Open Water
☐ 25-75% veg & 25-75% open water
☐ >75% veg (<25% open water)
☐ <25% veg (>75% open water)
☐ 100% cover or open water

Presence of Islands (in water-bodies)
☐ Several/many ☐ One/few ☐ None

Dead Woody Material
☐Moderate abundance(>25-50% of surface)
☐Low abundance (0-25% of surface)

Appendix D-3

FA Data Form

GPS Lat:
GPS Long:
GPS Elev:
GPS Datum: NAD83

Data Form
Rapid Procedure for Assessing Wetland Functional Capacity

Plot No: 3PP__________
Status: Y (full JD required for Y-T)

Project/Site: Donlin Gold	**Date:** _________/__________/______
Applicant/Owner: Donlin Gold LLC	**Borough:**
Investigator: 1) _____________2)______________ 3)____________	**State:** Alaska
Do Normal Circumstances Exist on the Site? YES NO	**Watershed:** ________________________________
Is the Site Significantly Disturbed (Atypical) YES NO	**Field Paper Plot/Tile No:** T__________________
Vegetation______ Soil _____ Hydrology ______	**Ortho No:** _________ ***Air Photo No:*** _________
Is the Area a Potential Problem Area (87 Manual)? YES NO	**Township:** _________ **Range:** ____________
Vegetation _____ Soil _____ or Hydrology _____	**Section:** _________ **Quad No.:** ___________
Distance to Nearest Disturbance (ft) __________________________	***General*** ______________________________
Type of Disturbance (if any)	***Location:*** ______________________________

Vegetation
T=Trace, <3 Percent. P=Present in polygon but not plot. E= Edge of plot, not in same polygon. 1/10-acre circular plot if site conditions allow.

Species	87 Strat	Ind. Stat	% ABS Cov	Tree Ht (ft)	DBH (in)	Species	87 Strat	Ind Stat	% ABS Cov	Additional Species
1.						9.				
2.						10.				
3.						11.				
4.						12.				
5.						13.				
6.						14.				
7.						15.				
8.						16.				
Percent of Dominant Species that are OBL, FACW, or FAC (Excluding FAC-): ___________% > 50% -- 87 Criteria Met * = Dominant Species	**Hydrophytic Vegetation 1987 Present?** Y N N(50)		**Database Calculated PI** ___________ **Hydrophytic?** Y N			17.				
						18.				
						19.				
						20. Bare Ground	N/A	N/A		
						21. Water	N/A	N/A		

Vegetation Comments:

% By Stratum (Magee – Wetlands Only –Database Calculated)
Canopy (Tree) ____ SAP = Sapling ____ TS = Tall Shrub ____ SUB = Submerged ___
SS = Short Shrub ____ DS = Dwarf Shrub ____ TH = Tall Herb ____ No. Species ________
SH= Short Herb ____ ML = Moss-Lichen _____ F = Floating ____ No. Layers ________

Final Project Vegetation Type :

Field Veg Type: ___________________________
Field JDWet_Code: ______________________
Cowardin Hydrologic Regime: ________________
Method: 50/20 Stratum. All Species ≥20% Dominant

Misc. Observations

Hydrology Comments:

Depth to Sat Soil: _______ (in) Depth to H2O Table: _____ (in)

Is this evaluation polygon part of a complex of contiguous wetlands? Yes No To Be Determined in GIS

Comments on isolation status:

Aspect (Degrees): _________ Direction: _________________
Percent Slope: ____________ Elevation (ft): ______________
Landform: ____
Macro-Topography: ____________________________________
Micro-Topography: _____________________________________
HGM Class: ____
Waterbody Type: _________________________
If Stream, Width: ______*(ft)* *Gradient:* ________ *(%)*
pH: _____ EC: _____ *DO:* ______ *BP*: ______ *Temp*: ____(C)
pH Meter #: EC Meter #: DO Meter #:

Soil Comments:

Field Taxonomy:
Additional Indicators: A12, A13, A14, A15

Histosol: Yes No Histic Epipedon: Yes No
Depth of Organic Mat ___________________ (inches)
Major Rooting Zone ______________________(inches)
Soil Temperature (20" Below Surface) _____________________(F)
Thixotropic: Yes No Slightly
Cryoturbated: Yes No Slightly
A~A : Yes No Delayed - Depth from Surface _______ (inches)
H2S: Yes No - Depth from Surface _______ (inches)

Wildlife Observations:

Engineering Concerns:

IKE#: ________ Digital Camera Used? ___
Other ___ #:____ _____ _____ _____ _____
Subject: _____ _____ _____ _____ _____
Site Marked on Field Map? Yes No

MISC. FACTORS

Answer based on personal knowledge of the area. This will ultimately be updated through the GIS.

☐ Public Ownership ☐ Private
☐ Wildlife Management Area
☐ Fisheries Management Area
☐ Historic/Archaeological Area
☐ Designated Protected Wetland
☐ Documented Habitat for Listed Species
☐ Regionally Scarce (< 5%) Wetland
☐ Recreational Use Area
☐ Subsistence Use Area %Cov =

LANDSCAPE VARIABLES

Estimate. GIS will update from digital mapping.

Size: ~ ______ (acres) _______(GIS)

☐ Small (<10 ac)
☐ Med. (10 -100 ac)
☐ Large (>100 ac)

Ratio of This Wetland Area to Total Watershed Area (GIS)_____ %

Estimate: Final will be calculated by GIS.

☐ High (>10%) ☐ Low (≤10%)

Wetland/Water Juxtaposition

A wetland or Water of the US directly abutting subject polygon upslope or down slope, including intermittent streams, constitutes a connection.

☐ Connected up & downstream
☐ Only connected above
☐ Only connected below
☐ Other wetlands nearby-not connected
☐ Wetland isolated

Watershed Land Use-% Urbanized

☐>50% ☐>25-50% ☐ 0-25%

Wetland Land Use Intensity

☐ High (agricult) ☐ Moderate (forestry)
☐ Low (open space)

SOIL VARIABLES

Based on dominant texture in upper 16" if mineral. If sandy loam, it's sandy. If finer (e.g., loam), it's silty (no clays!). If Histic Epipedon, Select 2.

☐ Soil lacking
☐ Fibric ☐ Gravelly
☐ Hemic ☐ Sandy
☐ Sapric ☐ Silty

Surficial Geology Type: *From GIS*

HYDROLOGIC VARIABLES

Surficial Deposit Under Wetland

GIS Data Take Precedence Where Available

☐ Low permeability stratified
☐ High permeability stratified
☐ Glacial till Compact? ☐

Micro-Relief of Wetland Surface

= Microtopography on pg 1 of form

☐ Pronounced >45 cm (>17.7 ")
☐ Well developed 15-45 cm (5.9-17.7")
☐ Poorly developed <15cm (<5.9 ")
☐ Absent

Wetland Water Regime (Cowardin)

Non-Tidal: ☐ A ☐ B ☐ C ☐ F ☐ H
Tidal: ☐ P ☐ N ☐ L
Fresh Tidal: ☐ S ☐ R ☐N

Surface Water Level Fluctuation

Counts only the depth above ground surface.

☐ High (≥8") ☐ Low <8")
☐ None (no surface water in summer)

Overbank Flooding Frequency

Return interval: Estimate based on presence of a stream or lake.

☐ > 5 yrs ☐ >2-5 yrs ☐ 1-2 yrs
☐ No overbank flooding (or stream/lake)

Evidence of Recent Sedimentation (transported by H20)

☐ No evidence
☐ Fluvaquent soil (or other ind'g deposits)
☐ Sediment observed on substrate

Basin Topographic Gradient

Same as slope of polygon.

☐ High (>2%) ☐ Low (≤2%)

Degree of Outlet Restriction

☐ Restricted (road/culverts, dam, log jams)
☐ Unrestricted outflow
☐ No outflow

Inlet/Outlet Class (polygon)

Inlet or outlet is a channel or very wet swale with surface water at some time. This does not include diffuse overland/through-soil flow. A seep does not constitute an inlet.

Inlet	Outlet
☐ None	☐ None
☐ Intermittent	☐ Intermittent
☐ Perennial	☐ Perennial

Water pH = ______ Measured using a meter in standing water within the polygon; or where absent -- in the soil pit-or not measured.

☐ No water
☐ Acid <5.5
☐ Circum-neutral 5.5-7.4
☐ Alkaline >7.4

Nested Piezometer Data

☐Not available (Field) – Possible GIS Update

Wetland's Substrate Elev. to Regional Piezometric Surface

☐ Not available (Field) – Possible GIS Update

Evidence of Seeps & Springs

Observation or evidence of seep or spring, or even mild evidence of seep or spring (e.g., toe of slope that abruptly becomes wet)

☐ No seeps or springs
☐ Seeps (Mapped? Yes or No - *GIS*)
☐ Perennial spring
☐ Intermittent spring

Fish Present? ☐ ____________

PLOT NO: 3PP__________

VEGETATION VARIABLES

Primary Vegetation Types

Check >1 if inclusions of >1 dominant (canopy) form. If >1, include % of its cover of the polygon. Entire polygon must be one HGM class.

☐ Vegetation lacking
☐ Forest, evergreen, needle-lvd%______
☐ Forest, deciduous, broad-lvd%______
☐ Forest, deciduous, needle-lvd%_____
☐ Scrb/shrb, evergrn, broad-lvd%______
☐ Scrb/shrb, evergrn, needle-lvd%_____
☐ Scrb/shrb, decid,.broad-lvd %_______
☐ Scrb/shrb, decid, needle-lvd%_______

Emergents:

☐ Persistent %____ ☐Non-persis%___
☐ Aquatic bed %____ ☐ Moss% _____
☐ Herbaceous %____ ☐ Lichen% _____

Number of Veg. Types __ (chkd abve)

Based on % cover of types checked above.

☐ Even distribution
(1 type =100%, 2 types = 45-55%, 3 types=30-35)
☐ Moderately even (30-44%, 56-70%)
☐ Highly uneven distribution (0-29,71-100)

Veg. Density/Dominance

100% minus bare ground or unvegetated water

☐ Sparse (0-20%)
☐ Low density (>20-40%)
☐ Medium density (>40-60%)
☐ High density (>60-80%)
☐ Very high density (>80-100%)

Vegetative Interspersion (within plot)

☐ High (small groups, well intrsp'd, lots of edge)
☐ Moderate (broken irregular rings, mod edge)
☐ Low (Lrg patches, concentric rings, low edge)

Plant Species Diversity

☐ Low (0-9 vascular species)
☐ Medium (10-18 vascular species)
☐ High (>18 vascular species)

Cover of Animal Food Plants

Estimate – Final Determined in GIS.

☐Low (5-25%) ☐Med (>25-50%) ☐ Hi (>50%)

Cover Distribution (based on vole)

☐ Continuous cover (of veg)
☐ Small scattered patches (of veg)
☐ 1 or more large patches, part open
☐ Solitary scattered stems (of veg)

Interspersion Cover/Open Water

☐ 25-75% veg & 25-75% open water
☐ >75% veg (<25% open water)
☐ <25% veg (>75% open water)
☐ 100% cover or open water

Presence of Islands (in water-bodies)

☐ Several/many ☐ One/few ☐ None

Dead Woody Material

☐Moderate abundance(>25-50% of surface)
☐Low abundance (0-25% of surface)

Appendix E

Description of 3PPI Data Collection and Analysis

E.1 Smart Client Application (SCA) Database Role

The variable conditions noted in the field and recorded on field data sheets were transferred to a digital facsimile of the field sheet in 3PPI's web-hosted Smart Client Application (SCA) database. The database, developed by 3PPI working with the database experts at Resource Data, Inc. (RDI), stores data from thousands of sites and enables quick analysis and summarization.

The screenshot shown in Figure E.1-1 shows a portion of the "Magee" page (tab) in the SCA database for field plot number 3PP1730 in the Crooked Creek watershed. In the screenshot, the arrow points to the entry for the variable *microrelief of wetland surface*.

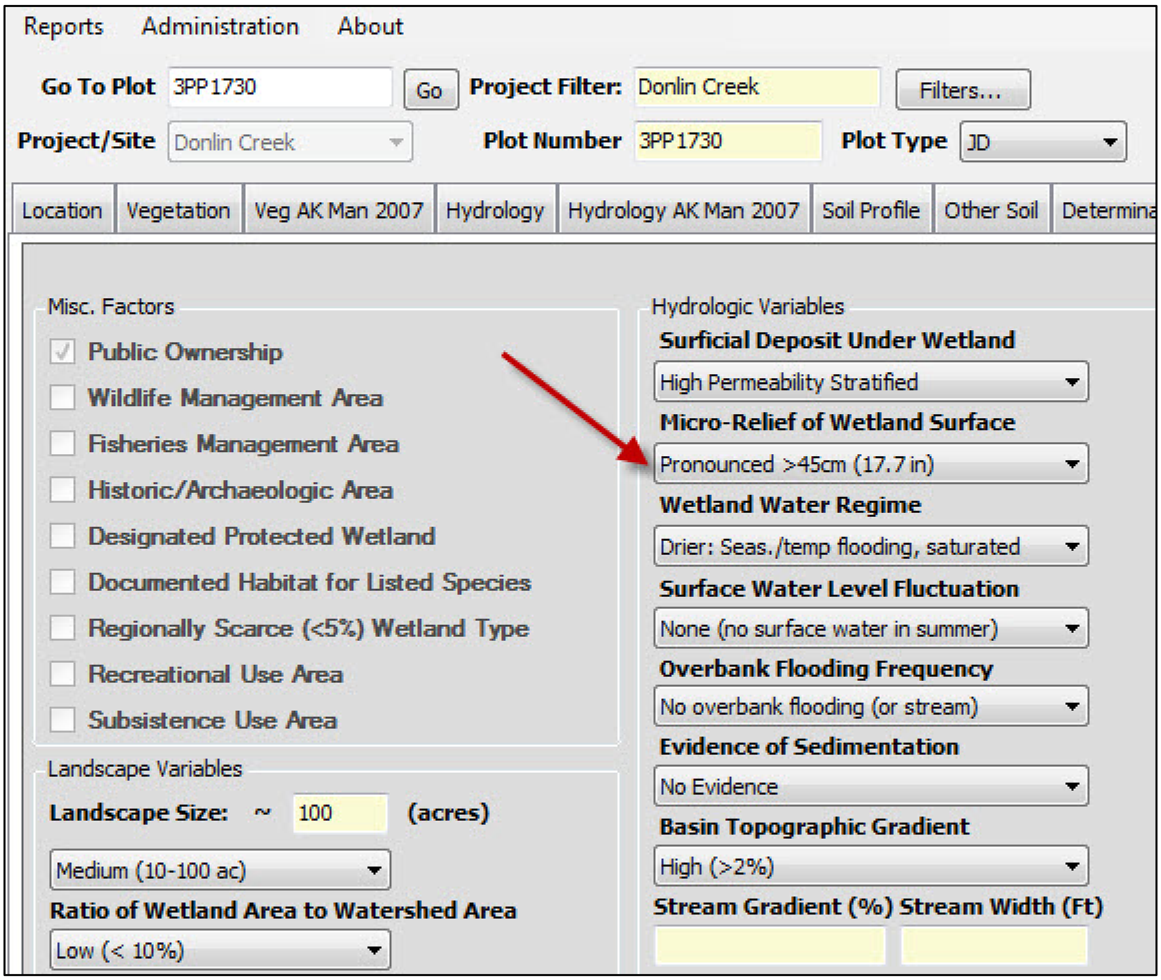

Figure E.1-1
Variable Conditions Noted for Field Plot Number 3PP1730 on a Portion of the Functional Assessment Tab in the SCA Database

The in-field scientist at the plot 3PP1730 site recorded "Pronounced >45cm" on the field data sheet, which was subsequently transferred to the SCA database by a data entry clerk and then reviewed by the original field scientist. The variable is used in the functional models for modification of groundwater discharge, modification of groundwater recharge, storm and flood water storage, modification of stream flow, and contribution to abundance and diversity of wetland fauna. For example, the microrelief variable is scored for the function *modification of groundwater recharge* for all hydrogeomorphic (HGM) classes in the project area as follows:

Condition	Variable Score
Absent	3
Poorly developed	3
Well developed	2
Pronounced	1

The SCA database uses the value of 1 for the microrelief variable in combination with values for the six other variables (e.g., wetland water regime) used in the formula for this function. In the case for plot 3PP1730, the resulting score for the function *modification of groundwater recharge* is 0.43 (see Figure E.1-2).

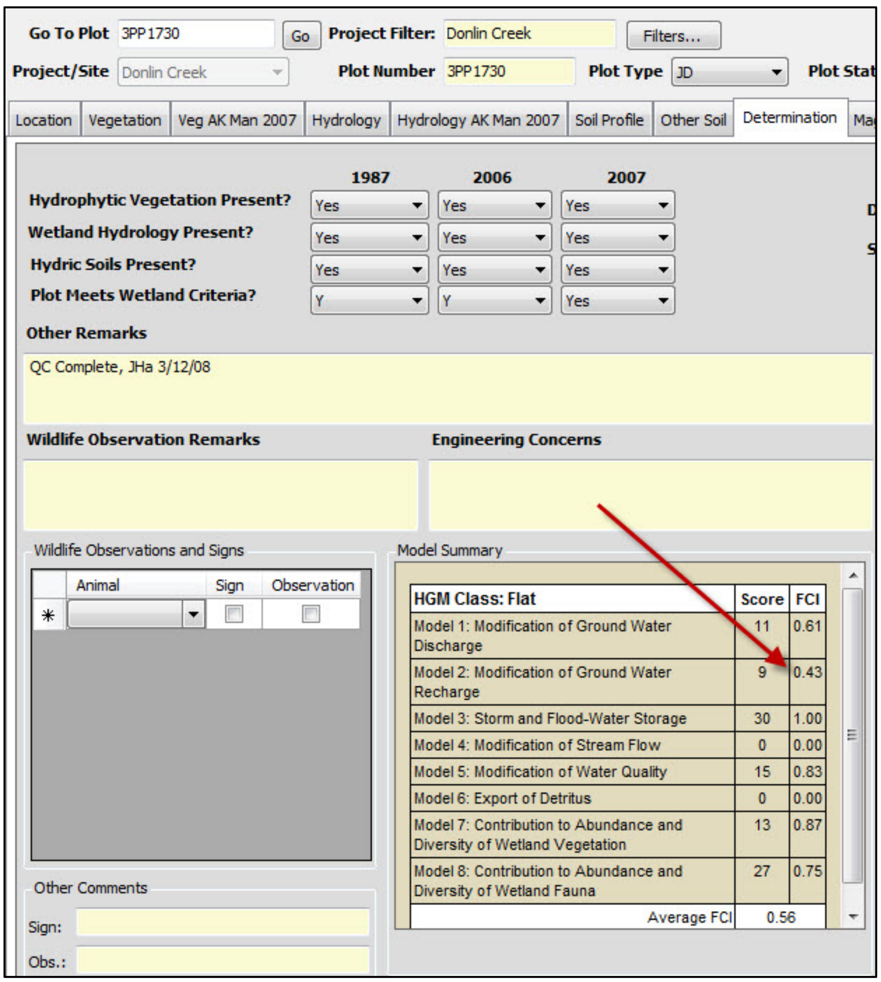

Figure E.1-2
FCI Score for Modification of Groundwater Recharge Function, Plot 3PP1730, SCA Database

Similar computations are repeated in the SCA for all functions. In many cases, the models for the functions vary slightly from one HGM class to the next, or the function may not apply to a particular HGM class. For example, the function *modification of groundwater recharge* does not apply to slope wetlands. For these reasons it is critical that scientists apply the correct HGM class designation to each mapped polygon.

E.2 Digital Mapping Process for Acreage/HGM Class Determinations

The SCA and the digital mapping data layer are the primary tools used to develop the functional capacity index (FCI) scores for the different functions for each mapped wetland and, as described in more detail in Section E.4, the functional capacity units (FCUs)—which are a conversion of FCI scores to area-based units that form the basis of the wetland debit or credit analysis. To ensure the accuracy and integrity of this process, strict controls and conventions are maintained throughout the field data collection efforts, digital wetland mapping phases, and in-office scoring of functional assessment (FA) variables.

The digital mapping process that results in discrete wetland map units (polygons) classified across a suite of classification systems (e.g., HGM, National Wetlands Inventory [NWI], and Donlin Gold project vegetation types) requires particular attention to standardization and quality control (QC) procedures. For FA purposes, the designation of wetland polygons according to their HGM class is especially important because the functional models commonly differ between HGM classes, and some functions are not applicable to all classes. The coding process for HGM classification is a manual interpretation of the imagery conducted on-screen, within the GIS mapping environment. The analyst synthesizes a variety of imagery characteristics (e.g., color and pattern) with other information such as slope, aspect, drainage patterns, and landscape setting to determine the appropriate HGM class for each wetland polygon. If the mapped unit includes a field plot, the HGM class selected by the field scientist is used by the map analyst to populate the HGM data field in wetland data layer. The field-plot HGM designations also assist the map analyst in classifying other polygons that have similar photo signatures or landform positions. Figure E.2-1 shows an area in the Snow Gulch watershed where three HGM classes have been identified by the map analyst.

The SCA “reads” the HGM code associated with data points in the polygons and selects the appropriate functional models for the delineated wetlands, which are input into point shapefiles and intersected with the mapping polygon layers. Once the FCIs are associated with their respective polygons, they can be multiplied by the size of the mapped polygon, as computed by the GIS. When the FCI scores for the functions are calculated, they are multiplied by the polygon acreage to derive the FCUs (FCI x acres = FCU). For example, the flats wetland (3PP1730) in Figure E.1-2 has an FCI score of 0.43 for the function *modification of groundwater recharge*.

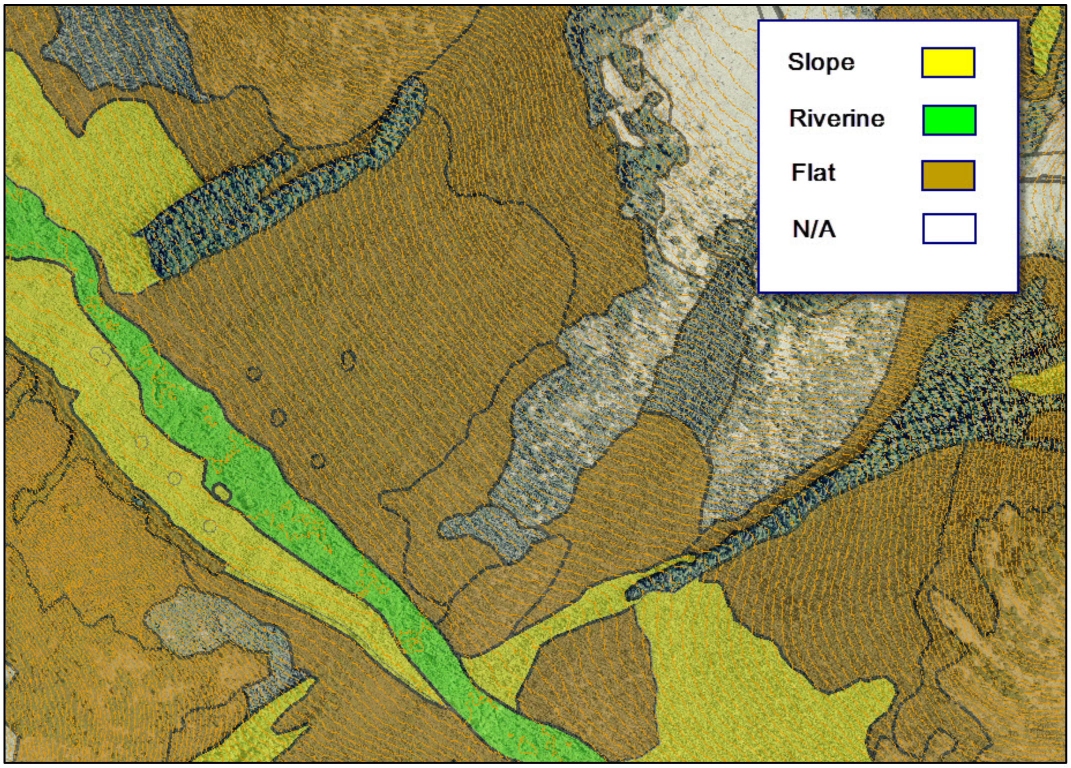

Figure E.2-1
HGM Classification for a Portion of the Donlin Gold Project Area: Snow Gulch Watershed

The polygon contains 13.8 acres of wetland, which results in an FCU value of 5.9 for the function *modification of groundwater recharge* as follows:

0.43 FCI x 13.8 acres = 5.9 FCUs (modification of groundwater recharge)

E.3 Transfer of FCI Data from SCA Database to Shapefiles

As described in Section E.2, the SCA database calculates the FCI scores for all mapping areas evaluated by 3PPI scientists in the field or by use of the office-based assessment process (extrapolated functional assessment [EFA] described in Section 2.3.3). A plot is developed in the SCA database to store the FA or EFA data for each unique mapping polygon (see Section E.2) that is expected to be directly impacted by the proposed project footprint. Once plot data are marked “QC complete” in the database, the database runs the mathematical models that derive the individual FCI scores for each function.

The screenshot in Figure E.3-1 shows the FCIs generated by the SCA database for plot 3PPI2035. The plot is classified as an HGM riverine wetland in the Anaconda Creek watershed that would be impacted by the proposed tailings storage facility. There are currently 15,479 plots in the SCA database that contain FCI ratings available for use in the quantitative FA process.

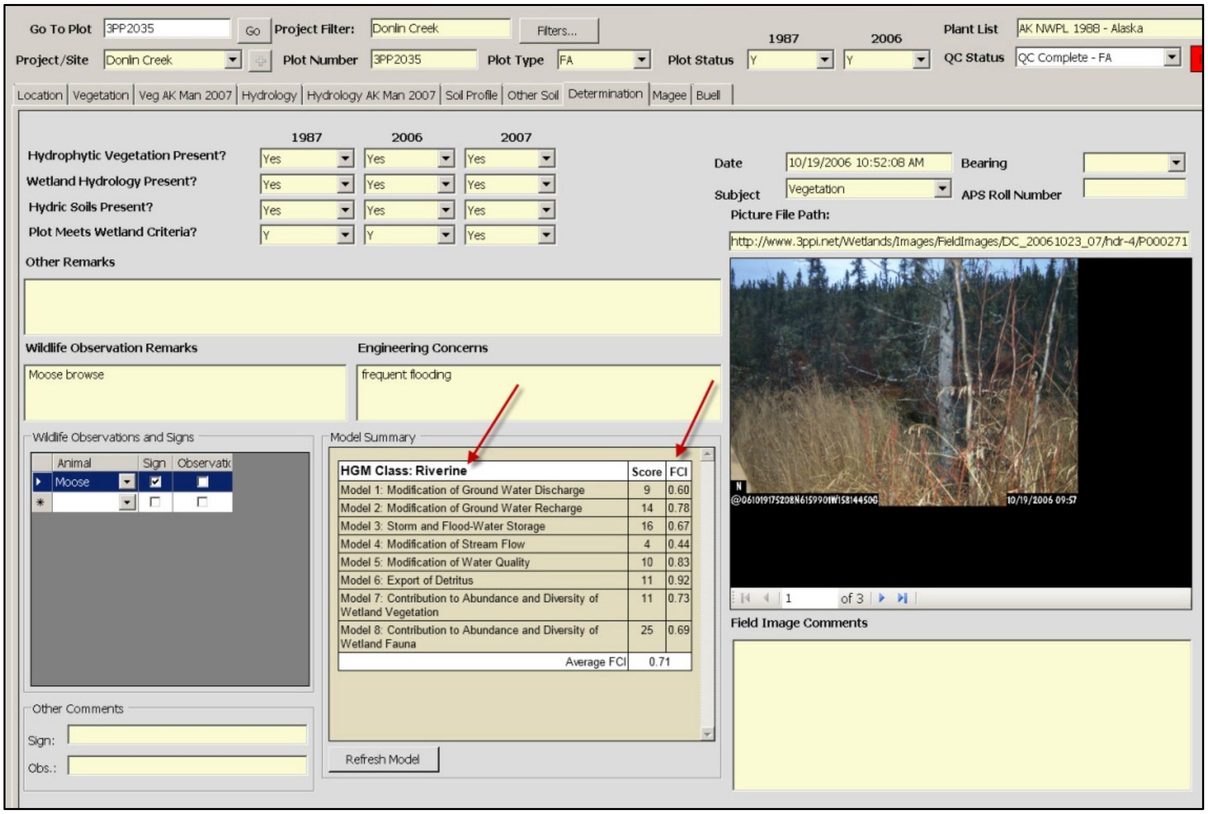

Figure E.3-1
Example of FCI Scoring in SCA Database for Plot 3PPI2035

After the FCIs are generated, the shapefile tool generator is run to create a point shapefile for the entire project area that contains all the key attributes needed to do a debit or credit analysis in the GIS environment. As shown in Figure E.3-2, key attributes include the plot number, location attributes, HGM classification, and the eight Magee rapid FA method model FCI results.

RDI intersects the shapefile point file with the mapping layer. Typically, there is only one field plot per polygon. However, in very large mapping units more than one evaluation point may have occurred. In this case, the RDI routine identifies the maximum average FCI score each of the plots and transfers the FCIs associated with that plot to the mapping polygon.

The end product, a mapping file that now includes the FCI attributes generated in the SCA database, is now ready for debit analysis. But first, RDI forwards this file to 3PPI for additional QC spot crosschecks between the database and the mapping file to verify the FCI scores were correctly transferred.

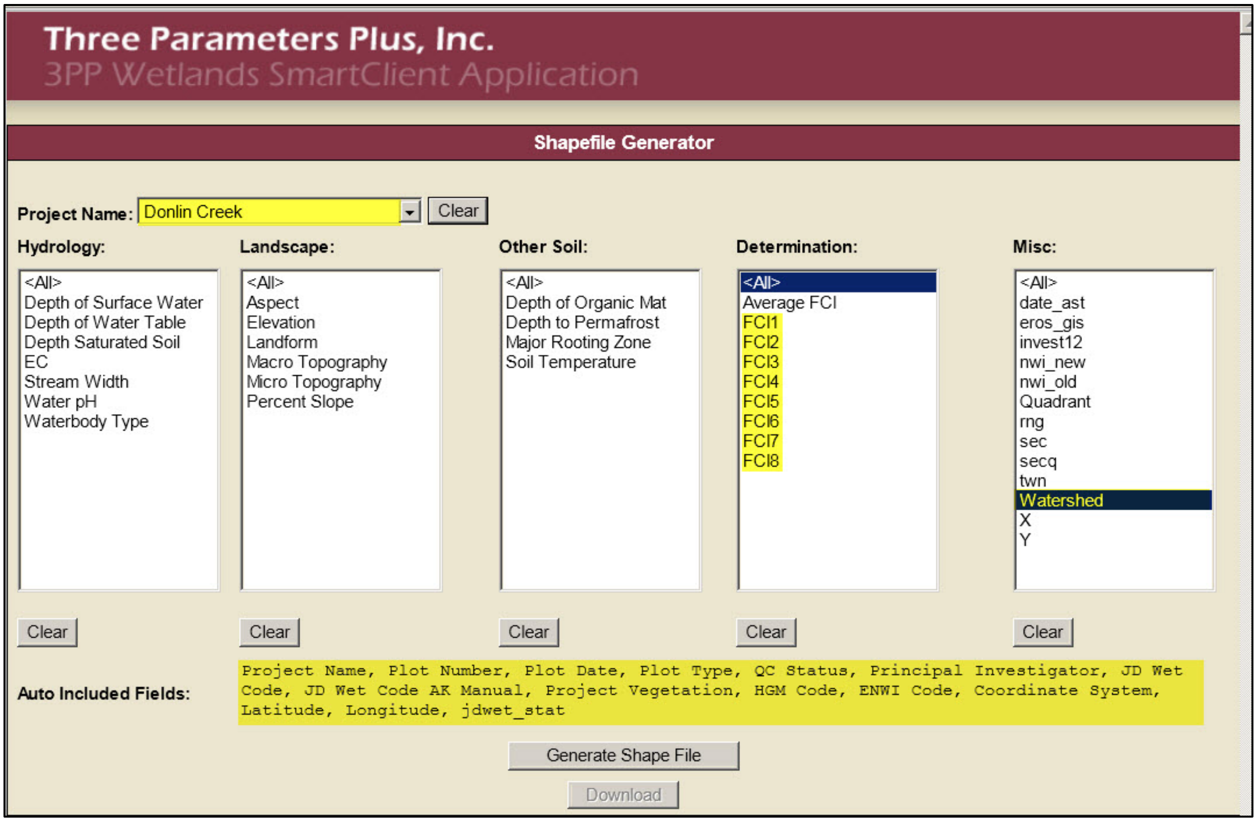

Figure E.3-2
Shapefile Tool Generator in 3PPI's SCA Database

E.4 Determination of Functional Capacity Units (FCUs)

The FCI score for a wetland function is directly applied to a discrete mapped wetland polygon regardless of the polygon's size. To account for the size difference in wetland polygons and the increased capacity to perform a function for a large wetland versus a small wetland, the FCI value is converted to an FCU. The FCU is determined simply by multiplying the FCI value times the wetland acreage. Determinations of FCUs from the database of mapped wetlands for the Donlin Gold project area are provided in Section 4.0 and Section 5.0.

In determining debits from the project footprint, only that area of a polygon that will be impacted is used to generate the FCUs. For example, if a road will fill half of a 10-acre wetland polygon, the FCI score of the polygon will be reduced by 50 percent. This occurs by multiplying the area of the impact (acres) by the FCI to calculate the impact FCUs. Again, each model produces a unique FCI for that polygon, so the analysis results in eight FCIs/polygon evaluated.

Appendix F

Project Vegetation Type Map Codes and Animal Food Plants

Vegetation Map Codes

Map Code	Project Vegetation Type
Broadleaf Forests	
CDF	Closed Deciduous Forest
ODF	Open Deciduous Forest
WDF	Woodland Deciduous Forest
Needleleaf Forests	
AF-L	Alluvial Forest - Lowland
CSF	Closed Spruce Forest
OBSF-S	Open Black Spruce Forest - Shrub
OSF-LM	Open Spruce Forest - Lichen-Moss
OSF-ML	Open Spruce Forest - Moss-Lichen
SF-BURN	Spruce Forest - Burned
SW-LM	Spruce Woodland - Lichen-Moss
SW-ML	Spruce Woodland - Moss-Lichen
SW-S	Spruce Woodland - Shrub
Mixed Forests	
AF-T	Alluvial Forest - Terraces
CMF	Closed Mixed Forest
OMF	Open Mixed Forest
WMF	Woodland Mixed Forest
Shrub Types	
AST	Alpine Shrub Tundra
CAS	Closed Alder Shrub
CAWS	Closed Alder – Willow Shrub
CWS	Closed Willow Shrub
DBLS	Dwarf Birch Low Shrub
OAS	Open Alder Shrub
OAWS	Open Alder – Willow Shrub
OWS	Open Willow Shrub
Herbaceous Types	
AH	Aquatic Herbaceous
BTG	Bluejoint Tall Grass
EA	Emergent Aquatic
TS	Tussock Sedge
Other Types	
BARE	Bare Ground, Talus, and Gravel Bars
FILL	Fill, Disturbed
LM	Lichen Mat
OW	Open Water
PV	Partially Vegetated
SNOW	Snow

Donlin Gold Animal Food Plants

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
ABIAMA-T	*Abies amabilis*	Pacific Silver Fir	TREE	Yes	http://plants.usda.gov/plantguide/pdf/pg_beoc2.pdf accessed 2/11 KCR	4
ACTRUB	*Actaea rubra*	Baneberry	TH	Yes	Limited use, mostly small mammals: Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	100
AGRREP	*Agropyron repens*	Quackgrass	SH	Yes	http://plants.usda.gov/java/charProfile?symbol=ELRE4 accessed 2/11 KCR	0
AGRSCA	*Agrostis scabra*	Rough Bentgrass	SH	Yes	http://plants.usda.gov/java/charProfile?symbol=AGSC5 accessed 2/11 KCR	91
ALENIG	*Alectoria nigrescens*	Lichen	ML	Yes	Vistnes and Nellemann (2008) reindeer KCR 12/09 (though not as much as ALOR)	2
ALEORC	*Alectoria orchreluca*	Lichen	ML	Yes	Vistnes and Nellemann (2008) reindeer KCR 12/09, change spelling to ochroleuca	15
ALNCRI	*Alnus crispa*	Green Alder (Shrub)	TS	Yes	Viereck (1972) Alaska Trees and Shrubs. U.S.D.A Forest Service.	7,549
ALNCRI-T	*Alnus crispa (Tree)*	Green aldeer (Tree)	TREE	Yes	Viereck (1972) Alaska Trees and Shrubs. U.S.D.A Forest Service.	28
ALNINC	*Alnus incana (shrub)*	Speckled Alder (Shrub)	TS	Yes	synonymy with ALTE - KCR	387
ALNINC-T	*Alnus incana (Tree)*	Speckled Alder (tree)	TREE	Yes	synonymy with ALTE - KCR	19
ALNSIN	*Alnus sinuata (shrub)*	Sitka Alder (shrub)	TS	Yes	www.wildlife.alaska.gov	2,728
ALNSIN-T	*Alnus sinuata (Tree)*	Sitka Alder (Tree)	TREE	Yes	www.wildlife.alaska.gov	3
ALNSPP	*Alnus spp.*	Unkeyed Alder	TS	Yes	ADF & G Division of Wildlife http://www.wildlife.alaska.gov/index.cfm?adfg=birds.plants accessed 11/09, KCR	1,164
ALNTEN	*Alnus tenuifolia (shrub)*	Thin-Leaf Alder (shrub)	TS	Yes	ADF & G Division of Wildlife http://www.wildlife.alaska.gov/index.cfm?adfg=birds.plants accessed 11/09, KCR	3,183
ALNTEN-T	*Alnus tenuifolia (Tree)*	Thin-Leaf Alder (Tree)	TREE	Yes	ADF & G Division of Wildlife http://www.wildlife.alaska.gov/index.cfm?adfg=birds.plants accessed 11/09, KCR	175
ALOAEQ	*Alopecurus aequalis*	Short-Awn Foxtail	SH	Yes	http://plants.usda.gov/java/charProfile?symbol=ALAE accessed 2/11 KCR	62
ANDPOL	*Andromeda polifolia*	Bog Rosemary	DS	Yes	vole, (moose) http://www.fs.fed.us/database/feis/plants/shrub/andpol/all.html#MANAGEMENT%20CONSIDERATIONS accessed 2/11, KCR	5,490
ANGLUC	*Angelica lucida*	Seawatch Angelica	SH	Yes	Atwell 1980 pg 302, bears, KCR 11/09	351
ARCALP	*Arctostaphylos alpina*	Alpine Manzanita	DS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	1,808
ARCALPR	*Arctostaphylos alpina var rubra*	Alpine Manzanita	DS	Yes	important vole cover moderate for forage, http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	1,218
ARCFUL	*Arctophila fulva*	Pendent Grass	SH	Yes	Finstad (2008) pg 51 KCR 11/09; http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	123
ARCLAT	*Arctagrostis latifolia*	Broad-Leaf Arctic-Bentgrass	TH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	557
ARCUVA	*Arctostaphylos uva-ursi*	Bearberry	DS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	171
ARNFRI	*Arnica frigida*	Snow Arnica	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	67
ARRELA	*Arrhenatherum elatius*	Tall Oatgrass	SH	Yes	http://plants.usda.gov	0
ARTARC	*Artemisia arctica*	Mountain Sagewort	SH	Yes	Hjeljord 1973 mountain goat KCR 11/09	135
ARTTIL	*Artemisia tilesii*	Sagebrush	DS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	424
ASTSIB	*Aster sibiricus*	Siberian Aster	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	182
ATHFIL	*Athyrium filix-femina*	Subarctic Lady Fern	SH	Yes	Grizzly, Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	660
BETGLA	*Betula glandulosa*	Tundra Dwarf Birch	SS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	6,302
BETNAN	*Betula nana*	Swamp Birch	SS	Yes	http://plants.usda.gov	14,978
BETNGL	*Betula nana x Betula glandulosa*	Dwarf/Swamp Birch Hybrid	SS	Yes	Both are independently referenced in database as wildlife use -KCR 11/09	89
BETOCC-T	*Betula occidentalis*	Spring Birch	TREE	Yes	Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	87
BETPAP	*Betula papyrifera s.l.*	Paper Birch (Snags)	N/A	Yes	Birds	353

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
	(Snags)					
BETPAP-SAP	*Betula papyrifera s.l. (Sapling)*	Paper Birch (Saplings)	SAP	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	6213
BETPAP-SE	*Betula papyrifera s.l. (Seedling)*	Paper Birch (Seedlings)	SAP	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	21
BETPAP-T	*Betula papyrifera s.l. (Tree)*	Paper Birch (Trees)	TREE	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	4036
BLESPI	*Blechnum spicant*	Deer Fern	SH	Yes	Hjeljord 1973 mountain goat KCR 11/09	0
BOSROS	*Boschniakia rossica*	Northern Groundcone	SH	Yes	Black Bears, Glacier Bay website www.nps.gov/glba/naturescience/bears.htm 11/09 KCR	330
CALCAN	*Calamagrostis canadensis*	Blue-Joint Reedgrass	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	13,360
CALINE	*Calamagrostis inexpansa*	Narrow-Spike Small-Reedgrass	SH	Yes	http://plants.usda.gov	181
CALLAP	*Calamagrostis lapponica*	Lapland Small-Reedgrass	SH	Yes	Reindeer, Pajunen et al 2008, KCR 11/09	126
CALLEP	*Caltha leptosepala*	Slender-Sepal Marsh-Marigold	SH	Yes	http://plants.usda.gov	199
CALNEG	*Calamagrostis neglecta*	Slimstem Reedgrass	SH	Yes	Reindeer, Staaland et al 1983, KCR 11/09	879
CALPUR	*Calamagrostis purpurascens*	Purple Reedgrass	SH	Yes	http://plants.usda.gov, KCR 4/11	26
CAMLAS	*Campanula lasiocarpa*	Common Alaska Bellflower	SH	Yes	Marmot, Hansen 1973, KCR 11/09	57
CAR(MA	*Carex (magellarica) paupercula*	Poor Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
CARADE	*Carex adelostoma*	Circumpolar Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARAEN	*Carex aenae*	Bronze Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARALB	*Carex albonigra*	Black-And-White-Scale Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARAMB	*Carex amblyorhyncha*	Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
CARANT	*Carex anthoxanthea*	Grassy-Slope Arctic Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARAQU	*Carex aquatilis*	Water Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	3,361
CARAQUM	*Carex aquatilis var. minor (stans)*	Water sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
CARARC	*Carex arctiformis*	Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	144
CARATH	*Carex atherodes*	Slough Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARATH1	*Carex athrostachya*	Slender-Beak Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARATR1	*Carex atrata*	Black-Scale Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	163
CARATR2	*Carex atrofusca*	Dark-Brown Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
CARAUR	*Carex aurea*	Golden-Fruit Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	16
CARBEB	*Carex bebbii*	Bebb's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARBIC	*Carex bicolor*	Two-Color Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	815
CARBIG	*Carex bigelowii*	Bigelow's Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage, lemmings Moen et al 1993 KCR 12/09	9,198
CARBIP	*Carex bipartita*	Arctic Hare's-Foot Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARBON	*Carex bonanzensis*	Yukon Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
CARBRU	*Carex brunnescens*	Brownish Sedge	SH	Yes	Fig 16 Emperor goose food Eisenhauer & Kirkpatrick 1977, KCR 11/09	1
CARBUX	*Carex buxbaumii*	Brown Bog Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARCAN	*Carex canescens*	Hoary Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	958
CARCAP	*Carex capillaris*	Hair-Like Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	55
CARCAP1	*Carex capitata*	Capitate Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
CARCHO	*Carex chordorrhiza*	Creeping Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	222
CARCON	*Carex concinna*	Low Northern Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	9
CARCRA	*Carex crawfordii*	Crawford's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	74
CARDEW	*Carex deweyana*	Short-Scale Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARDIA	*Carex diandra*	Lesser Panicled Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARDIS	*Carex disperma*	Soft-Leaf Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	16
CAREBU	*Carex eburnea*	Bristle-Leaf Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	3
CARECH	*Carex echinata*	Little Prickly Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	7
CARELE	*Carex eleusinoides*	Goose-Grass Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARENA	*Carex enanderi*	Enander's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CAREXS	*Carex exsiccata*	Beaked Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARFLA	*Carex flava*	Yellow Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARFRA	*Carex frankii*	Frank's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARGAR	*Carex garberi*	Elk Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARGME	*Carex gmelinii*	Gmelin's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARGYN	*Carex gynocrates*	Northern Bog Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	95
CARHAS	*Carex hassei*	Hasse's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARHEL	*Carex heleonastes*	Hudson Bay Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARHIN	*Carex hindsii*	Hinds' Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARHOL	*Carex holostoma*	Arctic Marsh Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARJAC	*Carex jacobi-peteri*	Anderson's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARKEL	*Carex kelloggii*	Kellogg's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARLAE	*Carex laeviculmis*	Smooth-Stem Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
CARLAN	*Carex lanuginosa*	Wooly Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARLAP	*Carex lapponica*	Lapland Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARLAS	*Carex lasiocarpa*	Woolly-Fruit Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	55
CARLAX	*Carex laxa*	Weak Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARLEN	*Carex lenticularis*	Shore Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARLEP	*Carex leptalea*	Bristly-Stalk Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	149
CARLIM	*Carex limosa*	Mud Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	348
CARLIV	*Carex livida*	Livid Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	52
CARLOL	*Carex loliacea*	Rye-Grass Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	418
CARLUG	*Carex lugens*	Spruce-Muskeg Sedge	SH	Yes	Based on synonymy to CABI1, KCR 11/09	987

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
CARLYN	*Carex lyngbyei*	Lyngbye's Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	80
CARMAC	*Carex macrochaeta*	Alaska Long-Awn Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	12
CARMAC1	*Carex mackenziei*	Mackenzie's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	85
CARMAC2	*Carex macloviana*	Falkland Island Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	3
CARMED	*Carex media*	Intermediate Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	182
CARMEM	*Carex membranacea*	Fragile-Seed Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	173
CARMER	*Carex mertensii*	Merten's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	5
CARMIC1	*Carex microglochin*	False Unicinia Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	366
CARMIC2	*Carex microchaeta*	Sedge	SH	Yes	Hjeljord 1973 mountain goat KCR 11/09	40
CARMIS	*Carex misandra*	Short-Leaf Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
CARNAR	*Carex nardina*	Nard Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARNES	*Carex nesophila*	Bering Sea Sedge	SH	Yes	Liberally interpreted as ssp nesophila of C michrochaeta from Hjeljord 1973 KCR 11/09	3,486
CARNEU	*Carex neurochlaena*	Northern Clustered Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	8
CARNIG	*Carex nigricans*	Black Alpine Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARNOR	*Carex norvegica*	Scandinavian Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPAC	*Carex pachystachya*	Thick-Head Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPAR	*Carex parryana*	Parry's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPAU	*Carex pauciflora*	Few-Flower Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	270
CARPEN	*Cardamine pensylvanica*	Pennsylvania Bitter-Cress	SH	Yes	http://plants.usda.gov	0
CARPHA	*Carex phaeocephala*	Mountain Hare Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPHY	*Carex phyllomanica*	Coastal Stellate Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPLE	*Carex plectocarpa*	Moose-Grass Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPLU	*Carex pluriflora*	Several Flowered Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	25
CARPOD	*Carex podocarpa*	Short-Stalk Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	1,870
CARPRA1	*Carex praegracilis*	Clustered Field Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPRE	*Carex preslii*	Presl's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARPYR	*Carex pyrenaica*	Pyrenaean Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARRAM	*Carex ramenskii*	Ramensk's Sedge	SH	Yes	Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	72
CARRAR	*Carex rariflora*	Loose Flowered Sedge	SH	Yes	(especially Emperor geese Eisenhauer and Kirkpatrick 1977 KCR)Tande& Lipkin (2003) Wetland Sedges of Alaska. University of Alaska Anchorage	888
CARRAY	*Carex raynoldsii*	Raynolds' Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
CARRHY	*Carex rhynchophysa*	Northwest Territory Sedge	SH	Yes	synonym CAUT - KCR	864
CARROS	*Carex rostrata*	Beaked Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	186
CARROT	*Carex rotundata*	Round-Fruit Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,233
CARRUP	*Carex rupestris*	Curly Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARSAX	*Carex saxatilis*	Russet Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	255
CARSCI	*Carex scirpoidea*	Canadian Single-Spike Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	190
CARSCO	*Carex scopulorum*	Holm's Rocky Mountain	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
		Sedge				
CARSIT	*Carex sitchensis*	Sitka Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	9
CARSPE	*Carex spectabilis*	Showy Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	18
CARSPP	*Carex spp.*	Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	5,684
CARSTY	*Carex stylosa*	Long-Style Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2,213
CARSUB	*Carex subspathacea*	Hoppner's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARSYC	*Carex sychnocephala*	Many-Head Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARTEN	*Carex tenuiflora*	Sparse-Flower Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	330
CARURS	*Carex ursina*	Bear Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CARUTR	*Carex utriculata*	Northwest Territory Sedge	SH	Yes	muskrats waterfowl Tande& Lipkin (2003) Wetland Sedges of Alaska. KCR	112
CARVAG	*Carex vaginata*	Sheathed Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	118
CARVIR	*Carex viridula*	Little Green Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	3
CARWIL	*Carex williamsii*	William's Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
CARX S	*Carex x stipata*	Stalk-Grain Sedge	SH	Yes	as Carex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
CETCUC	*Cetraria cucullata*	Lichen	ML	Yes	now Flavocetraria cucullata (PDB 12/09); caribou www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR	891
CETISL	*Cetraria islandica*	Lichen	ML	Yes	Finstad (2008) pg 51 KCR 11/09, Vistnes and Nellemann (2008) reindeer, also moose mountain goat http://www.fs.fed.us/database/feis/plants/ accessed KCR 12/09	1,029
CETNIV	*Cetraria nivalis*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.(now Flavocetraria nivalis, PDB 12/09)	10
CETSPP	*Cetraria spp.*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	1,058
CHACAL	*Chamaedaphne calyculata*	Leatherleaf	DS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company;http://www.plants.usda.gov/plantguide/pdf/pg_chca2.pdf accessed 2/2011 KCR	6,951
CLAARB	*Cladina arbuscula*	Lichen	ML	Yes	Danell (1994) Food Plant Selection by Reindeer during Winter in Relation to Plant Quality. Blackwell Publishing.	108
CLADIN-X	*Cladina spp.*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	4,146
CLADON-X	*Cladonia spp.*	Lichen	ML	Yes	voles and reindeer though less than Cladina; http://www.fs.fed.us/database/feis/plants/ moose www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR	3,802
CLAMIT	*Cladina mitis*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	1,607
CLAMUL	*Cladonia multiformis*	Lichen	ML	Yes	voles and reindeer though less than Cladina; http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	1
CLARAN	*Cladina rangiferina*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	5,130
CLASTE	*Cladina stellaris*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	3,902
CLAUNC	*Cladina uncialis*	Lichen	ML	Yes	Forbes (2006) Reindeer Management in Northernmost Europe. Springer-Verlag Berlin Heidelberg.	1
CORCAN	*Cornus canadensis*	Canada Bunchberry	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2,164
CORSTO	*Cornus stolonifera*	Red-Osier Dogwood	SS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	3
CORSUE	*Cornus suecica*	Swedish Dwarf Dogwood	SH	Yes	no info found 12/09, but closely related to COCA KCR 2/11	2,376
DELBRA	*Delphinium brachycentrum*	Arctic Larkspur	SH	Yes	as Delphinium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	5
DELGLA	*Delphinium glaucum*	Tower Larkspur	TH	Yes	as Delphinium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	201
DELSPP	*Delphinium spp.*	Larkspur	TH	Yes	as Delphinium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
DROANG	*Drosera anglica*	English Sundew	SH	Yes	no info found 12/09, but closely related to DRRO	7
DROROT	*Drosera rotundifolia*	Round-Leaf Sundew	SH	Yes	moose, waterfowl, Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	1,738

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
DRYDIL	*Dryopteris dilatata*	Mountain Woodfern	SH	Yes	moose & low for goat grouse, under Dryopteris spp, Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	1,791
DRYOCT	*Dryas octopetala*	Eightpetal Mountain-Avens	DS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	185
ELACOM	*Elaeagnus commutata*	American Silver-Berry	SS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	17
ELEACI	*Eleocharis acicularis*	Least Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	88
ELEKAM	*Eleocharis kamtschatica*	Kamchatka Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
ELEMAC	*Eleocharis macrostachya*	Creeping Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
ELEPAL	*Eleocharis palustris*	Creeping Spikerush	SH	Yes	http://plants.usda.gov/factsheet/pdf/fs_elpa3.pdf accessed 2/11 KCR	178
ELEPAU	*Eleocharis pauciflora*	Few-Flower Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
ELEQUA	*Eleocharis quadrangulata*	Square-Stem Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
ELESPP	*Eleocharis spp.*	Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	33
ELEUNI	*Eleocharis uniglumis*	Creeping Spikerush	SH	Yes	as Eleocharis spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
ELYARE	*Elymus arenarius*	Sea Lyme-Grass	TH	Yes	Emperor goose nest & food Eisenhauer & Kirkpatrick 1977, KCR 11/09	2
EMPNIG	*Empetrum nigrum*	Black Crowberry	DS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company; http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	13,057
EPIANG	*Epilobium angustifolium*	Fireweed	SH	Yes	http://plants.usda.gov	4914
EPILAT	*Epilobium latifolium*	River Beauty	SH	Yes	http://plants.usda.gov	260
EQUARV	*Equisetum arvense*	Field Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	4,058
EQUFLU	*Equisetum fluviatile*	Water Horsetail	SH	Yes	Finstad (2008) pg 51 KCR 11/09	2,257
EQUHYE	*Equisetum hyemale*	Rough Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	45
EQUPAL	*Equisetum palustre*	Marsh Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	952
EQUPRA	*Equisetum pratense*	Meadow Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	2,806
EQUSCI	*Equisetum scirpoides*	Dwarf Scouring-Rush	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	737
EQUSPP	*Equisetum spp.*	Unkeyed Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	558
EQUSYL	*Equisetum sylvaticum*	Woodland Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	9,771
EQUVAR	*Equisetum variegatum*	Variegated Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	353
EQUX L	*Equisetum x litorale*	Shore Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	11
EQUX T	*Equisetum x trachyodon*	Rough-Tooth Horsetail	SH	Yes	In interior AK Equisetum spp= imp for black bear, as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	0
ERIALP	*Eriophorum alpinum*	Alpine Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	50
ERIANG	*Eriophorum angustifolium*	Narrow-Leaf Cotton-Grass	SH	Yes	Finstad (2008) pg 51 KCR 11/09	1,453
ERIBRA	*Eriophorum brachyantherum*	Short-Anther Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	0
ERICAL	*Eriophorum callitrix*	Sheathed Cotton-Grass	SH	Yes	included in E vaginatum in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	19
ERICHA	*Eriophorum chamissonis*	Russet Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	0
ERIGRA	*Eriophorum gracile*	Slender Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	0
ERIOPH-X	*Eriophorum spp.*	Unkeyed Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	1,391
ERIPOL	*Eriophorum polystachion*	Coldswamp Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	0
ERIRUS	*Eriophorum russeolum*	Russet Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	2,187
ERISCH	*Eriophorum scheuchzeri*	Scheuchzer's Cotton-Grass	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	260

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
ERISPI	*Eriophorum spissum*	Hare's-Tail	SH	Yes	general imp of Eriophorum spp for caribou Thompson & McCourt 1981, KCR	11
ERIVAG	*Eriophorum vaginatum*	Tussock Cotton-Grass	SH	Yes	Finstad (2008) pg 51 Cebrian et al (2008) KCR 11/09	4,653
FLACUC	*Flavocetraria cucullata*	Curled Snow Lichen	ML	Yes	http://web.uvic.ca/~stucraw/part2AM.html	4
GERERI	*Geranium erianthum*	Woolly Geranium	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	268
GLYSTR	*Glyceria striata*	Fowl Manna Grass	SH	Yes	used in Europe to feed domestic geese 11/09 KCR	29
GYMDRY	*Gymnocarpium dryopteris*	Oak Fern	SH	Yes	Grizzly, Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	626
HERLAN	*Heracleum lanatum*	Cow-Parsnip	TH	Yes	http://plants.usda.gov	246
HIPVUL	*Hippuris vulgaris*	Common Mare's-Tail	SUB	Yes	Finstad (2008) pg 51 KCR 11/09	185
HYLSPL	*Hylocomium splendens*	Feather Moss	ML	Yes	http://www.fs.fed.us/database/feis/plants/bryophyte/hylspl/all.html	5,721
IRISET	*Iris setosa*	Beach-Head Iris	SH	Yes	no info, but Ive seen it grazed … -KCR 11/09	126
IRISPP	*Iris spp.*	Unkeyed Iris	SH	Yes	as IRSE	0
JUNCAS	*Juncus castaneus*	Chestnut Rush	SH	Yes	http://plants.usda.gov	259
LARLAR	*Larix laricina (Snags)*	American Larch (Snags)	N/A	Yes	Birds	4,640
LARLAR-SAP	*Larix laricina (Sapling)*	American Larch (Saplings)	SAP	Yes	http://plants.usda.gov/plantguide/pdf/pg_lala.pdf accessed 2/11 KCR	8,855
LARLAR-T	*Larix laricina (Tree)*	American Larch (Trees)	TREE	Yes	http://plants.usda.gov/plantguide/pdf/pg_lala.pdf accessed 2/11 KCR	6,394
LEMMIN	*Lemna minor*	Lesser Duckweed	F	Yes	as Lemna spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
LEMTRI	*Lemna trisulca*	Star Duckweed	F	Yes	as Lemna spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
LINBOR	*Linnaea borealis*	Twinflower	DS	Yes	Bighorn shep, caribou, Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	2,029
LUEPEC	*Luetkea pectinata*	Partridge-Foot	DS	Yes	Hjeljord 1973 mountain goat KCR 11/09	2
LUPARC	*Lupinus arcticus*	Arctic Lupine	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	144
LYCALP	*Lycopodium alpinum*	Alpine Clubmoss	SH	Yes	http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	78
LYCANN	*Lycopodium annotinum*	Stiff Clubmoss	SH	Yes	Kenai moose as in http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	4,177
MENARV	*Mentha arvensis*	Field Mint	SH	Yes	http://plants.usda.gov	0
MERPAN	*Mertensia paniculata*	Tall Bluebells	SH	Yes	British Columbia Ag & Lands www.agf.gov.bc.ca/range/RangeID/RangeAlpha.html KCR 11/09	2,198
MIMGUT	*Mimulus guttatus*	Common Large Monkey-Flower	SH	Yes	http://plants.usda.gov	94
MYRGAL	*Myrica gale*	Sweetgale	SS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	1,885
NUPPOL	*Nuphar polysepala*	Rocky Mountain Pond-Lily	F	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	6
PARPAL	*Parnassia palustris*	Northern Grass-Of-Parnassus	SH	Yes	alternate forage for arctic geese (KCR 11/09)	1,172
PELAPT	*Peltigera apthosa*	Lichen	ML	Yes	mountain goats moose www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR low value to caribou http://www.fs.fed.us/database/feis/plants/	1,021
PELMAL	*Peltigera malacea*	Lichen	ML	Yes	mountain goats, moose www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR	540
PENSER	*Penstemon serrulatus*	Cascade Beardtongue	SH	Yes	mountain goats, moose www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR	0
PETFRI	*Petasites frigidus*	Arctic Sweet Coltsfoot	SH	Yes	ground squirrels, Batzli & Sobaski (1980) KCR 11/09	4,195
PHYALE	*Phyllodoce aleutica*	Aleutian Mountainheath	DS	Yes	Hjeljord 1973 mountain goat KCR 11/09	0
PICEA-T	*Picea sp. (Tree)*	Spruce Tree	TREE	Yes	Both Picea spp. listed as food source- KCR2/2011	2
PICGLA	*Picea glauca (Snags)*	White Spruce (Snags)	N/A	Yes	Birds	400
PICGLA-SAP	*Picea glauca (Sapling)*	White Spuce (Saplings)	SAP	Yes	http://plants.usda.gov	5,042

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
PICGLA-T	*Picea glauca (Tree)*	White Spruce (Trees)	TREE	Yes	http://plants.usda.gov	5,865
PICMAR	*Picea mariana (Snags)*	Black Spruce (Snags)	N/A	Yes	Birds	4,568
PICMAR-SAP	*Picea mariana (Sapling)*	Black Spruce (saplings)	SAP	Yes	http://www.wildlife.alaska.gov	12,896
PICMAR-T	*Picea mariana (Tree)*	Black Spruce (Trees)	TREE	Yes	http://www.wildlife.alaska.gov	11,476
PLASCO	*Plagiobothrys scouleri*	Scouler Popcorn-Flower	SH	Yes	no info except "Plagiobpthrys spp" listed as nitrate accumulator and, thus, harmful to livestock by Halsey (1998), also preferred deer food Evans et al (1976) -KCR 11/09	16
PLESCH	*Pleurozium schreberi*	Moss	ML	Yes	listed as "no entry" for wildlife in http://www.fs.fed.us/database/feis/plants/bryophyte but is a preferred food for lemmings in Australia www.anbg.gov.au but not preferred by sheep marrs et al 1988 sites accessed 12/09 KCR	4,429
POAALP	*Poa alpigena*	Low Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	7
POAALP1	*Poa alpina*	Alpine Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
POAANN	*Poa annua*	Annual Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
POAARC	*Poa arctica*	Arctic Bluegrass	SH	Yes	Reindeer and geese, Bakker and Loonen 1998	181
POABRA	*Poa brachyanthera*	Short-Anther Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POACOM	*Poa compressa*	Canada Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POAEMI	*Poa eminens*	Large-Flower Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POAHIS	*Poa hispidula*	Hispid Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POALAN	*Poa lanata*	Wool Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	18
POALEP	*Poa leptocoma*	Bog Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POAMAC	*Poa macrocalyx*	Large-Glume Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POANEM	*Poa nemoralis*	Woods Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POANOR	*Poa norbergii*	Norberg Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
POAPAL	*Poa palustris*	Fowl Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	27
POASPP	*Poa spp.*	Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,651
POASTE	*Poa stenantha*	Northern Bluegrass	SH	Yes	Hjeljord 1973 mountain goat KCR 11/09	112
POATRI	*Poa trivialis*	Rough Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
POATUR	*Poa turneri*	Turner's Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POAVAS	*Poa vaseyochloa*	Oregon Bluegrass	SH	Yes	as Poa spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POLACU	*Polemonium acutiflorum*	Sticky Tall Jacob's-Ladder	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable	2,615
POLBIS	*Polygonum bistorta*	Meadow Bisort	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	606
POLJUN	*Polytrichum juniperinum*	Moss	ML	Yes	lemmings www.fs.fed.us accessed 12/09 KCR	5
POLMUN	*Polystichum munitum*	Western Swordfern	SH	Yes	http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	0
POLVIV	*Polygonum viviparum*	Viviparous Knotweed	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	441
POPBAL-SAP	*Populus balsamifera (Sapling)*	Cottonwood (Saplings)	SAP	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	597
POPBAL-T	*Populus balsamifera (Tree)*	Cottonwood (Trees)	TREE	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	907
POPTRE-SAP	*Populus tremuloides (Sapling)*	Quaking Aspen (Saplings)	SAP	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	986
POPTRE-T	*Populus tremuloides (Tree)*	Quaking Aspen (Trees)	TREE	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	195
POTALP	*Potamogeton alpinus*	Alpine Pondweed	F	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
POTANS	*Potentilla anserina*	Silverweed	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTARG	*Potentilla arguta*	Tall Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTBIF	*Potentilla biflora*	Two flower cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
POTDIV	*Potentilla diversifolia*	Varileaf Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTEGE	*Potentilla egedii*	Pacific Silverweed	SH	Yes	alternate forage for arctic geese (KCR 11/09); as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	75
POTEPI	*Potamogeton epihydrus*	Ribbon-Leaf Pondweed	F	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTFIL	*Potamogeton filiformis*	Fine-Leaf Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTFOL	*Potamogeton foliosus*	Leafy Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTFRI	*Potamogeton friesii*	Fries's Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	30
POTFRU	*Potentilla fruticosa*	Shrubby Cinquefoil	SS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/2011 KCR	1,651
POTGRA	*Potamogeton gramineus*	Grassy Pondweed	F	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
POTHYP	*Potentilla hyparctica*	Arctic Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTNAT	*Potamogeton natans*	Floating-Leaf Pondweed	F	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
POTNOR	*Potentilla norvegica*	Norwegian Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	83
POTPAL	*Potentilla palustris*	Marsh Cinquefoil	SH	Yes	Dept of Ecology, WA, www.ecy.wa.gov, accessed 11/09, KCR; as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	5,167
POTPEC	*Potamogeton pectinatus*	Sago Pondweed	SUB	Yes	Emperor goose nest & food Eisenhauer & Kirkpatrick 1977 pg 51, KCR 11/09	0
POTPRA	*Potamogeton praelongus*	White-Stem Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTPUS	*Potamogeton pusillus*	Small Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTRIC	*Potamogeton richardsonii*	Richardson Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTSP.	*Potamogeton sp.*	Pondweed	SUB	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
POTSPP	*Potentilla spp.*	Unkeyed Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	9
POTUNI	*Potentilla uniflora*	One-flowered cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
POTVAG	*Potamogeton vaginatus*	Sheathed Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTVIR	*Potentilla virgulata*	Twigy Cinquefoil	SH	Yes	as Potentilla spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
POTZOS	*Potamogeton zosteriformis*	Flat-Stem Pondweed	SUB	Yes	as Potamogeton spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RANHYP	*Ranunculus hyperboreus*	Arctic Butter-Cup	SH	Yes	as Ranunculus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	45
RANLAP	*Ranunculus lapponicus*	Lapland Butter-Cup	SH	Yes	as Ranunculus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	164
RIBTRI	*Ribes triste*	Swamp Red Currant	SS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/2011 KCR	1,804
ROSACI	*Rosa acicularis*	Prickly Rose	SS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/2011 KCR	3,337
RUBACA	*Rubus acaulis*	Dwarf Raspberry	SH	Yes	reviewed as R arcticus (synonym is ssp), Plant database, KCR 11/09	25
RUBARC	*Rubus arcticus*	Arctic Raspberry	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4,612
RUBCHA	*Rubus chamaemorus*	Cloudberry	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	12,081
RUMACE	*Rumex acetosella*	Sheep Sorrel	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
RUMACE1	*Rumex acetosa ssp. acetosa*	Garden Sorrel	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMARC	*Rumex arcticus*	Arctic Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2,774
RUMCRI	*Rumex crispus*	Curly Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
RUMDOM	*Rumex domesticus*	Dooryard Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMFUE	*Rumex fueginus*	Sea-Side Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMMAR	*Rumex maritimus*	Golden Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMMEX	*Rumex mexicanus*	Mexican Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
RUMOBT	*Rumex obtusifolius*	Bitter Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMOCC	*Rumex occidentalis*	Western Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
RUMSAL	*Rumex salicifolius*	Willow Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
RUMSPP	*Rumex spp.*	Unkeyed Rumex	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	174
RUMTRI	*Rumex triangulivalvis*	Triangular-Valve Dock	SH	Yes	as Rumex spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SALALA	*Salix alaxensis*	Felt-Leaf Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,196
SALALA-T	*Salix alaxensis (Tree)*	Felt-Leaf Willow (Tree)	TREE	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	448
SALARB	*Salix arbusculoides*	Little-Tree Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	3,478
SALARC	*Salix arctica*	Arctic Willow	DS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	314
SALARC1	*Salix arctophila*	Oval-Leaf Willow	DS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SALBAR	*Salix barclayi*	Barclay Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,953
SALBEB	*Salix bebbiana*	Bebb Willow	TS	Yes	Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	1,564
SALBEB-T	*Salix bebbiana (Tree)*	Bebb Willow (tree)	TREE	Yes	Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	161
SALBRA	*Salix brachycarpa*	Barren-Ground Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SALCAN	*Salix candida*	Hoary Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SALCHA	*Salix chamissonis*	Chamisso Willow	DS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	10
SALCOM	*Salix commutata*	Under-Green Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
SALEXI	*Salix exigua s.l.*	Sandbar Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	4
SALFAR	*Salix farriae*	Farr Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SALFUS	*Salix fuscescens*	Alaska Bog Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	3,100
SALGLA	*Salix glauca*	Gray-Leaf Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,945
SALHAS	*Salix hastata*	Halberd Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	58
SALLAS	*Salix lasiandra*	Pacific Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	206
SALMON	*Salix monticola s.l.*	Mountain Willow	TS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	198
SALMYR	*Salix myrtillifolia*	Blue-Berry Willow	DS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	103
SALNIP	*Salix niphoclada*	Barrenground Willow	SS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	24
SALOVA	*Salix ovalifolia*	Oval-Leaf Willow	DS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	7
SALPHL	*Salix phlebophylla*	Skeleton-Leaf Willow	DS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	43
SALPLA	*Salix planifolia*	Diamond-Leaf Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	154
SALPOL	*Salix polaris*	Polar Willow	DS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	132
SALPSE	*Salix pseudo-myrsinites*	Firmleaf Willow	SS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis	28

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
					http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	
SALPUL	*Salix pulchra*	Diamond-Leaf Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	11,140
SALRET	*Salix reticulata*	Net-Leaf Willow	DS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	1,105
SALRIC	*Salix richardsonii*	Richardson Willow	SS	Yes	as Salix spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1,400
SALROT	*Salix rotundifolia*	Least Willow	DS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	2
SALSCO	*Salix scouleriana*	Scouler Willow	TS	Yes	Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	1,081
SALSCO-T	*Salix scouleriana (Tree)*	Scouler's Willow (tree)	TREE	Yes	Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	31
SALSET	*Salix setchelliana*	Setchell Willow	DS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	0
SALSIT	*Salix sitchensis*	Sitka Willow	SS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	26
SALSPH	*Salix sphenophylla*	Wedge-Leaf Willow	SS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	518
SALSPP	*Salix spp.*	Unkeyed Willow	SS	Yes	widespread use of willows Seaton (2002) UAF MS Thesis http://www.wildlife.alaska.gov/pubs/techpubs/propubs/seaton_thesis.pdf accessed 11/09 KCR	2,261
SAMRAC	*Sambucus racemosa*	European Red Elder	SS	Yes	http://plants.usda.gov/factsheet/pdf/fs_sara2.pdf; accessed 2/11 KCR	320
SANOFF	*Sanguisorba officinalis*	Great Burnet	SH	Yes	grazed in England (plus SAMI = high value) econet. Http://maps.chesshire.gov.uk	95
SAXPUN	*Saxifraga punctata*	Dotted Saxifrage	SH	Yes	ground squirrels, Batzli & Sobaski (1980) KCR 11/09	1,020
SCIACU	*Scirpus acutus*	Hard-Stem Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SCIAME	*Scirpus americanus*	Olney's Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SCICES	*Scirpus cespitosus*	Tufted Bulrush	SH	Yes	as Trichophorum cespitosum, caribou, Storeheier et al 2002 KCR; http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	605
SCIMAR	*Scirpus maritimus*	Saltmarsh Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SCIMIC	*Scirpus microcarpus*	Small-Fruit Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
SCISPP	*Scirpus spp.*	Unkeyed Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
SCISUB	*Scirpus subterminalis*	Subterminate Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SCIVAL	*Scirpus validus*	Soft-Stem Bulrush	SH	Yes	as Scirpus spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	1
SEDROS	*Sedum rosea*	Roseroot Stonecrop	SH	Yes	Hjeljord 1973 mountain goat KCR 11/09	647
SOLMUL	*Solidago multiradiata*	Mountain Golden-Rod	SH	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	359
SORSCO	*Sorbus scopulina*	Greene's Mountain-Ash	SS	Yes	Birds, small mammals, moose, bears, http://www.fs.fed.us accessed 5/2011 KCR	197
SORSCO-T	*Sorbus scopulina (Tree)*	Greene;s mountain ash (Tree)	TREE	Yes	Birds, small mammals, moose, bears, http://www.fs.fed.us accessed 5/2011 KCR	1
SPAEME	*Sparganium emersum*	Narrow-Leaf Burreed	F	Yes	as Sparganium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SPAHYP	*Sparganium hyperboreum*	Northern Burreed	F	Yes	as Sparganium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	2
SPAMIN	*Sparganium minimum*	Small Burreed	F	Yes	as Sparganium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	0
SPASPP	*Sparganium spp.*	Bur-reed	SUB	Yes	as Sparganium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	83
STEREO-X	*Stereocaulon spp.*	Fruticose Lichen	ML	Yes	van der wal et al 2001 suggest this spp unaffected by reindeer grazing exclusion though listed on	594

Acronym	Latin Name	Common Name	Magee Stratum[a]	Magee Animal Use	Animal Use notes	Frequency[b]
					www.lichen.com/fauna.html Sharnoff & Rosentreter BLM Idaho accessed 12/09 KCR	
THAVER	*Thamnolia vermicularis*	Whiteworm lichen	ML	Yes	Nesting Bulletin of CA Lichen Society 2009 vol16	0
TRIMAR	*Triglochin maritimum*	Seaside Arrow-Grass	SH	Yes	as Triglochin spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	24
TRIPAL	*Triglochin palustre*	Marsh Arrow-Grass	SH	Yes	as Triglochin spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	27
VACALA	*Vaccinium alaskaense*	Alaska Blueberry	SS	Yes	as synonym V. alaskensis in Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	16
VACCES	*Vaccinium cespitosum*	Dwarf Blueberry	DS	Yes	as Vacc sp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11, KCR	0
VACMIC	*Vaccinium microcarpus*	Blueberry	DS	Yes	as synonym V. oxycoccus in Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	615
VACOVA	*Vaccinium ovalifolium*	Early Blueberry	SS	Yes	as Vaccinium spp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable	4,494
VACOXY	*Vaccinium oxycoccos*	Small Cranberry	DS	Yes	Limited use, mostly small mammals: Forest Service http://www.fs.fed.us/database/feis/plants/ accessed 11/09, KCR	9,725
VACPAR	*Vaccinium parvifolium*	Red Huckleberry	SS	Yes	as Vacc sp. http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11, KCR	0
VACSPP	*Vaccinium spp.*	Huckleberry	SS	Yes	All Vaccinum spp.=yes	24
VACULI	*Vaccinium uliginosum*	Bog Blueberry	DS	Yes	Peterson (1986) A field Guide to Trees and Shrubs. Houghton Mifflin Company.	15,438
VACVIT	*Vaccinium vitis-idaea*	Mountain Cranberry	DS	Yes	http://www.adfg.alaska.gov/index.cfm?adfg=wildlifelandscaping.planttable accessed 2/11 KCR	13,902
VALCAP	*Valeriana capitata*	Clustered Valerian	SH	Yes	particularly valuable in subalpine British Columbia Ag & Lands www.agf.gov.bc.ca/range/RangeID/RangeAlpha.html KCR 11/09	1,429
VIOADU	*Viola adunca*	Hooked-Spur Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	69
VIOBIF	*Viola biflora*	Twin-Flower Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	44
VIOEPI	*Viola epipsila*	Dwarf Marsh Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	152
VIOGLA	*Viola glabella*	Smooth Yellow Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	0
VIOLAN	*Viola langsdorffii*	Alaska Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	1
VIOPAL	*Viola pallens*	Northern White Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	0
VIOREN	*Viola renifolia*	Kidney-Leaf White Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	0
VIOSPP	*Viola spp.*	Unkeyed Violet	SH	Yes	Viola generally as "high" for caribou Brathen & Oksanen (2001), KCR 11/09	2,594

Notes:

a. Magee Stratum codes: DS = dwarf shrub, F = forb, ML = moss lichen, SAP = sapling, SH = short herb, SS = scrub shrub, SUB = submerged/aquatic species, TREE = tree, and TS = tall shrub.

b. Frequency is the number of times this species has been used in a project data plot in the 3PPI SCA database.